MODEL AIRPLANE NEWS

48120

January 1995

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JANUARY 1995 VOLUME 123, NUMBER 1

MODEL AIRPLANE NEWS

FEATURES

ABOVE: David Ribbe shows off his electric-powered MiG-15 (3.5 minute flights) at the '94 Aviation Expo in Ankeny, IA. Photo by Rich Graham.

ON THE COVER: Joe Kotula's rendition of the U.S. Army's XFM-1 Bell "Airacuda" was first published on the cover of our March 1938 issue. If you're interested, that issue contained a three-view (by Thomas A. Naylor of Buffalo, NY) of this interesting design.

FEATURES

CONSTRUCTION

COLUMNS

COLUMNS

DEPARTMENTS

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EDITORIAL

TOM ATWOOD

COMMUNITY ACTION WINS A FLYING SITE

Flying site acquisition and preservation is a key issue faced by modelers, and one dear to our hearts. As suburban development consumes more and more land adjacent to existing R/C flying sites, there is an ever-growing pressure to close down such sites because of noise and safety concerns. Occasionally, a novel approach to this challenge emerges—one that is so successful it warrants publication. Joe Beshar, AMA District 2 VP, has developed a concept for acquiring and maintaining R/C flying fields that shows interesting promise.

Over a period of years, Joe has enlisted the support of local government authorities in the development of an R/C flying facility known as the Bergen County Model Airdrome (BCMA). The Airdrome, shown in the photos, is in New Jersey only a few miles from the George Washington Bridge. The site is next to a recreational park in a densely occupied suburban area where flying fields are tough to come by. The BCMA includes a paved runway and parallel grass runway, a graded parking lot, a dock for float-flying on the adjacent waterway, a couple of acres of well-cut grass, and a large sun roof and shelter with a separate, weatherproof frequency-control room. By anybody's standards, this is an elegant flying site.

Much of the site was constructed at county expense, which is a testament to the interest a local parks department may legitimately take in an R/C flying facility. Also notable is that the BCMA is cosponsored by 11 local clubs. Any member of any of these clubs can become a member of the BCMA for only $20 per year. The site is open every day, seven days a week, and is one of the most professionally laid-out I've seen. The story behind this unusual and helpful case study in flying-site acquisition will be published in a future article. Perhaps modelers in your area, too, can use the techniques pioneered by Joe to enlist the aid of local government. Stay tuned.

The Bergen County Model Airdrome has a 259-foot paved runway and parallel grass strip—not to mention a nearby dock for float flying.

The transmitter impound area is at the center of the extended sheltered pit area. The building structure was built entirely with donations of materials and money from the 11 involved clubs.

FUN FIRST

Speaking of club fields, nothing drives up enthusiasm at a local R/C meet like a well-organized, competitive, sport fun-fly contest that is loads of fun. The variations are endless: using a string-mounted whiffle ball to snag ribbons posted near the ground; attempting to cut crepe or toilet paper dropped from on high; racing an electric glider across a timed speed course; landing on a simulated carrier deck; maximizing the number of spins after going dead-stick; knocking out balloons in a circuit around the field; the list goes on and on. We are compiling a list of fun-fly events for publication (with attribution) and would like to hear from clubs and individuals who have novel approaches to R/C fun at the field. If you'd like to have a chance to see your ideas published in *Model Airplane News,* please send your photos, drawings and ideas to Debra Sharp's attention, care of Air Age, 251 Danbury Rd., Wilton, Connecticut 069897; or fax her at (203) 762-9803; Internet: debs@airage.com.

SCRATCH-BUILDING BONANZA

Take a careful look at the *Plans Directory* published in this issue; your next scratch-building project may be waiting for you there! The *Directory* includes over 380 of the best plans published in *Model Airplane News* over more than 30 years. A special six-page section by aviation authority Jim Newman highlights optimal designs for a variety of essential control mechanisms. Scratch-builders with PCs: see Dave Garwood's survey of 32 modeling design programs for your IBM compatible or Macintosh. ■

MODEL AIRPLANE NEWS

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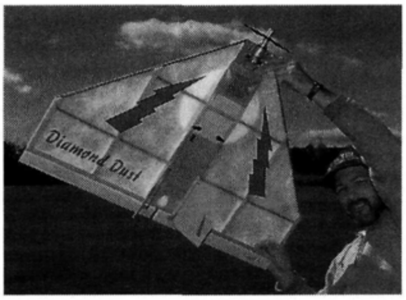
AIRWAVES

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," **Model Airplane News,** 251 Danbury Road, Wilton, CT 06897. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we cannot respond to every one.

ERRATA

In the "Society of Antique Modelers" article in the November '94 issue, we incorrectly reported that Mrs. Bob Dodds was the secretary of that group. Bob Dodds, who was the former secretary, passed away last December. The new SAM secretary is Larry Clark, Box 528, Lucerne Valley, CA 92326. We apologize for any inconvenience this may have caused.



Russ Pribanic shows off his Diamond Dust fun-fly airplane at the KRC Electric Fly. It incorporates fun-fly-competition technology, as shown by its carbon-fiber leading edge and spars and its few widely spaced ribs. At the '94 KRC Electric Fly, it was clocked at 101mph. It was powered by an Astro Flight FAI 5-turn 05 motor spinning a Graupner 7x7 fixed prop on eight 1400mAh cells. The plane, which is not supplied with this power system, is manufactured by Gilbert Aircraft; (616) 772-1832.

FLYING HERSHEY BAR?

After reading October's issue of *Model Airplane News*' Field & Bench review of the Sig Fazer by Jim Simpson, I felt I had to reply to his comments directed toward "pure competition fun-fly" airplane designs (I am not commenting on the Sig product, which is a sport fun-fly design, or his review of the Sig product). I hope that his opening comments, which I considered somewhat negative, were made more in jest than seriousness. I have never met Mr. Simpson on the competition fun-fly circuit, and I am not sure that Mr. Simpson understands the difference between sport fun flys and the competition fun flys sponsored by the NCFFA (National Competition Fun Fly Association).

NCFFA events are not concerned with aircraft appearance or taxiing ability; they are geared to maximum performance and speed of execution and completion. An example would be "roops." This event requires a takeoff that starts the clock; the aircraft must then do one roll and one loop to complete a roop. The number of roops completed is usually five, followed by a touchdown. The touchdown completes the event and stops the clock. An average time to complete this event is 12 seconds. Performance such as this requires a highly specialized airframe. Current champions use carbon fiber to strengthen critical areas. The single large wheel aids in fast, hard landings that would destroy a conventional geared aircraft.

As a four-time national fun-fly winner and a contributor to the development of competition fun flying, I feel it necessary to address Mr. Simpson's comments. The current airplanes are designed for maximum performance and durability for the events flown. Each task is a timed maneuver from aircraft start to aircraft finish (touchdown). Competition fun-fly airplanes are not designed for cosmetic beauty or high-speed flight. They do excel in the close-in, radical maneuverability that the events require. In the hands of skilled pilots, they do not act like "drunk ducks," nor do they "flip and flop" through the maneuvers. These airplanes have been evolving from the early Sweet Stiks and Miss Marthas, through profile fuselages, to the designs seen at major competition fun-fly events today.

If you like low and slow and highly maneuverable aircraft, then thank the competition fun-fly class for promoting that aspect of modeling. I can not understand how the last 10 years of development of this type of flying has set modeling back 30 years, as suggested by Mr. Simpson. We feel

that it has advanced all modeling as it has developed. The next time you need a light, powerful muffler and reach for a mousse-can muffler, thank competition fun-fly design. If you use carbon fiber or fiberglass/carbon tube, again, it is the competition fun-fly design that has made it widespread.

At a time when modeling is losing participants, it is unfortunate to see a fellow modeler criticize other types of flying as less important than one personally enjoyed. If we all flew the same things we did 30 years ago, what would I be flying today? Competition has always benefited all aspects of modeling. I would not be a four-time competition fun-fly winner without the help and support of my friends and competitors.

JERRY L. SMITH
Paducah, KY

Jerry, thank you for your comments. We at Model Airplane News clearly understand the opening of Jim Simpson's article to have been written in jest and with the intention of entertaining the reader with a bit of humor. Jim's comments mirror our own feelings: "Of course, my opening comments were in jest. Unfortunately, I can not claim original authorship for any of them. Some of these comments we hear in the pit area, and some we have seen written elsewhere. These same comments were heard 30 to 40 years ago about other types of airplanes, which subsequently have come into prominence."

None of us had the intention to offend, and as the picture above shows, applied technology from the fun-fly-competition world continues to influence modeling at large.

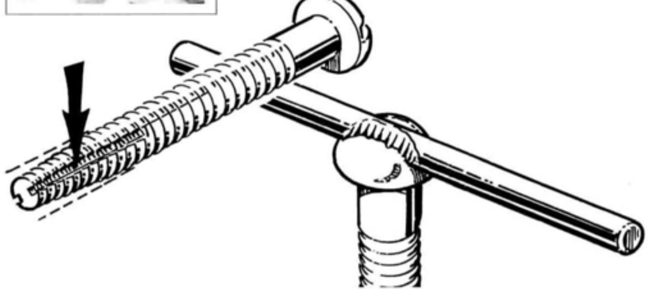
For more information about the NCFFA, contact secretary/treasurer Tom Holmes, Jervey Rd., Greenville, SC 29609; (803) 233-1912. TA

(Continued on page 163)

HINTS & KINKS

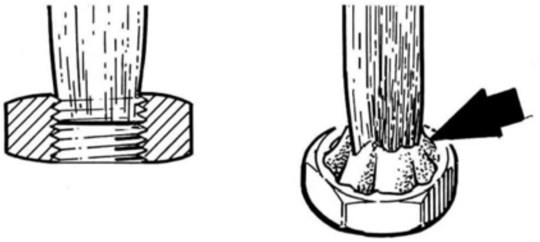
JIM NEWMAN

Model Airplane News will give a free one-year subscription (or one-year renewal if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman c/o Model Airplane News, 251 Danbury Rd., Wilton, CT 06897. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can't acknowledge each one, nor can we return unused material.



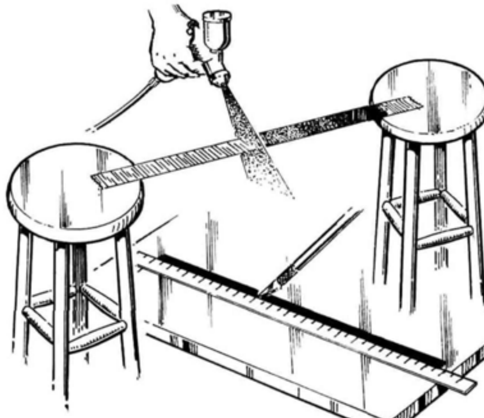
HOMEMADE TAP

Good for wing-bolt holes, this tap is made out of a $\frac{1}{4}$-20 steel screw. Grind the first $\frac{3}{8}$ inch (9mm) to a slight taper, then use a Dremel cutoff wheel to grind the slot in each side (arrowed). Finally, solder a $2\frac{1}{2}$-inch (63mm) length of $\frac{1}{8}$-inch-diameter (3mm) music wire across the top as a T-handle. ***John Burnett, APO***



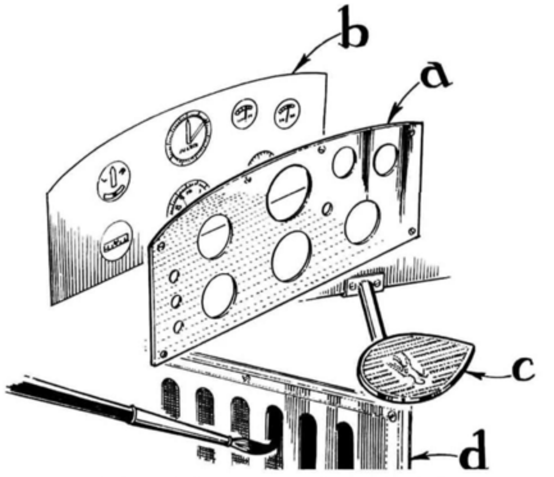
EASY NUT STARTER

Jam a balsa stick partway into a nut; this allows you to reach down into almost inaccessible depths. For small nuts, reinforce the attachment with a little Blue Tack or modeling clay (arrowed). When the nut is started, just tug the stick free and continue tightening with a socket wrench. ***Peter Kraus, Windsor NSW, Australia***



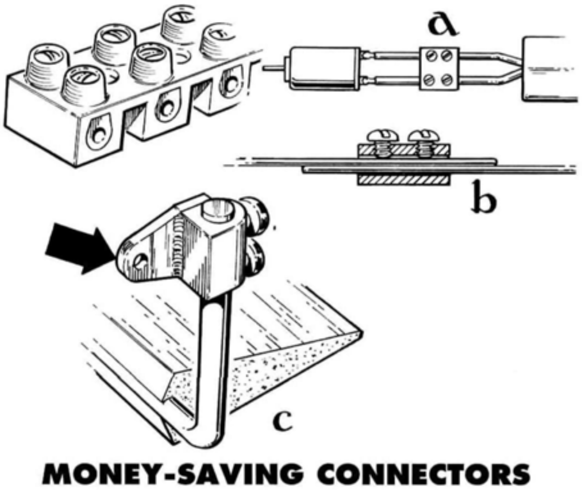
CHEAP TRIM TAPES

Stretch 2-inch-wide (50mm) masking tape between two stools, then spray it with your color choice of quality epoxy paint. After it has cured, lay the tape out on a sheet of glass, then cut it into the required widths. This tape bends around tight curves and doesn't fall off in the sun. Dave recommends an overcoat of clear epoxy after application. ***Dave Platt, Palm Bay, FL***



COMPUTER EMBOSSING

For a great embossed look, lay out instrument panels, etc., with a CAD or graphics program, then do dot-matrix printouts on self-adhesive, hardware-store, aluminum-foil tape. This instrument panel (a) has a nice dot-screen finish. Remove circles to show the instruments (b), which were done on glossy paper with a LaserJet color printer. The beautiful embossed foot step (c) replicates the cast-alloy Fairchild 24 step, and (d) is a typical louvered engine panel, which can be cut out or filled in with black paint. Cross-hatched, or "quilted" interior panels are also possible. Note: don't remove tape from printer, as the ink contains a lubricant for the pins. ***Bob Charron, Lynn, MA***

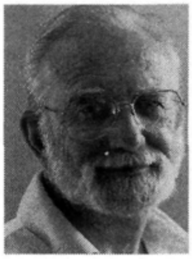


MONEY-SAVING CONNECTORS

These inexpensive blocks of electric connectors are from Radio Shack. Use them to connect electric motors (a), to clamp adjustable pushrods (b), or to make this unique adjustable aileron horn (c). The $\frac{1}{16}$-inch (1.5mm) brass plate, arrowed, is soldered to the side of the connector. Many other uses are possible.

Wee-Meng Lee, Singapore, Republic of Singapore

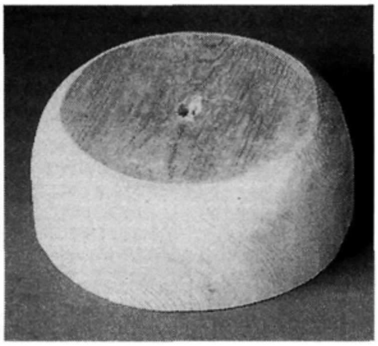
HOW TO:



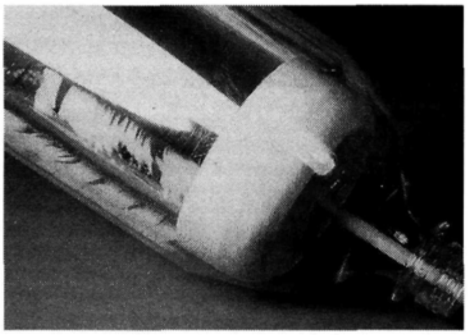
RANDY RANDOLPH

HEAT-SHRINK PLASTIC PARTS

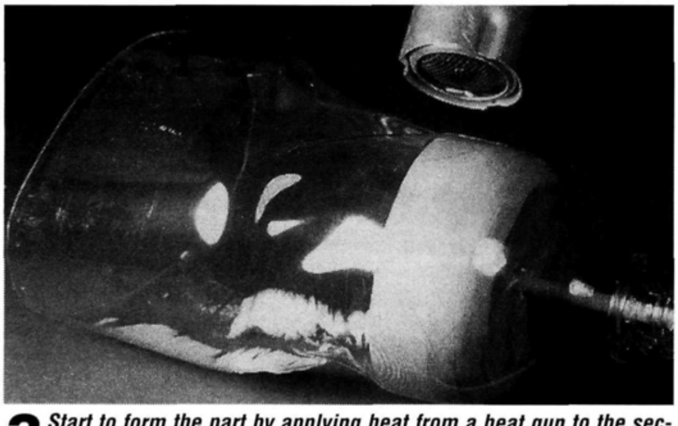
VACUUM-FORMING HAS been the method of choice used by most modelers to form plastic parts for their projects; unfortunately, it's a process that requires equipment not usually found in a modeler's workshop. Vern Williams of Little Rock, AR, offers this simple method for forming plastic parts that's almost like magic! Actually, it's better than magic, because it can be used to form cowls, cockpit canopies, windshields, cabin enclosures, hatch covers, or almost any part that will fit inside a plastic soft-drink bottle. The photos show the way.



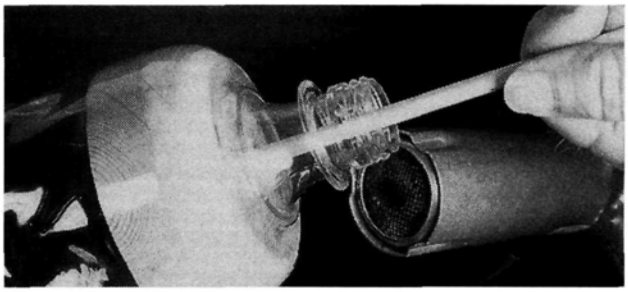
1 *The hardest part of the process is making a form for the part. When you make the form, allow for the thickness of the plastic and leave a little trim room all around. The form can be made of balsa, hardwood, plaster of Paris, or what have you. There must be a ¼-inch hole in the form's center in which a 12-inch-long dowel can be inserted to use as a handle. The form shown will make a cowl for a Mister Mulligan.*



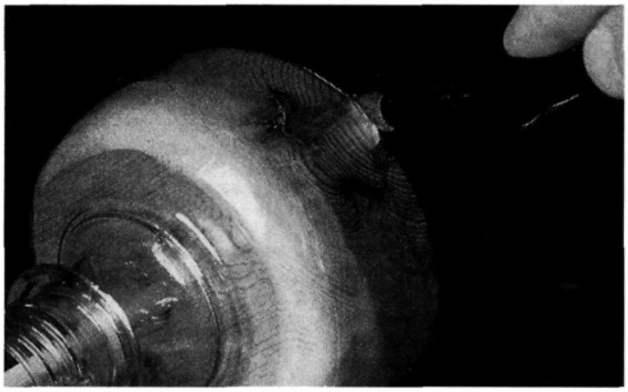
2 *Cut the bottom off the bottle, insert the form, and snug it down against the neck of the bottle so that the dowel handle sticks out of the mouth. A two-liter bottle is shown, but the size of the form should dictate the size of the bottle. A clearance of ½ to ¾ inch between the part and the bottle is about right.*



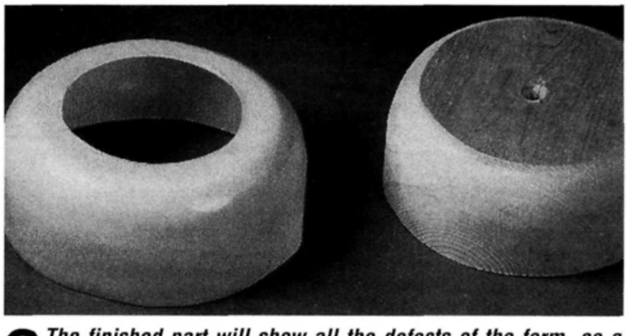
3 *Start to form the part by applying heat from a heat gun to the section of the form that's away from the neck of the bottle. The heat will shrink the bottle down against the form; this will prevent the form from slipping out of the bottle. Work around the form, and shrink the bottle down against the sides of the form while you turn the bottle with the dowel handle.*



4 *Move the heat gun to the neck end of the form, and shrink the bottle against the bottom of the form. Again, turn the bottle with the handle. The shrinking takes very little time—less than a minute.*



5 *Trim the bottle away from the widest part of the form, and use the dowel handle to push the form out of the part. After the form has been removed, the part can be trimmed to final shape. Oddly shaped parts can be formed in the same way using blocks of wood to take up the extra space in the bottle.*



PHOTOS BY RANDY RANDOLPH

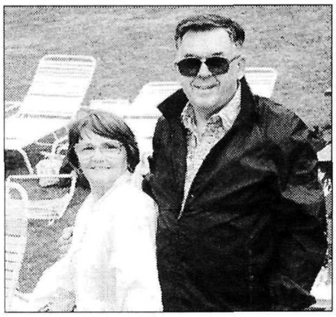
6 *The finished part will show all the defects of the form, so a nice, smooth finish on the form works best. The formed parts can be painted on the inside for that perfect "deep" finish.*

AstroFlight News

Astro Dominates APBA Electric Nationals

June 26, Tacoma Washington

Team Astro Cobalt Racing Motors dominated the third Annual APBA Electric Boat Nationals held in Tacoma, Washington on June 26. Seven out of eight first place trophies were won by Astro powered boats. Astro's new SUPER-HOT FOUR-TURN marine motors powered a number of winners. These two new motors deliver peak horsepower at 25,000 RPM. They are now available as Model #306 (05-size for 7 and 8 cells) and Model #326 (25-size for 12 cells).



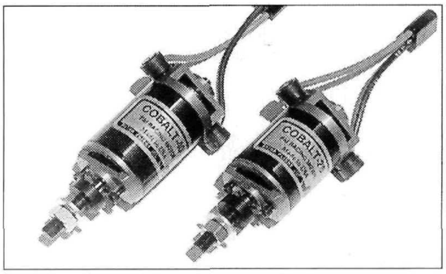
Bob and Suzanne Boucher enjoying the action at the APBA/DPI Leisure Sports Nationals.

EVENT	*PLACE*	*DRIVER*	*BOAT*	*MOTOR*
1/16 Scale Unlimited	***1st***	***Bob Welch***	***DPI American Dream***	***Astro #306***
7-Cell Open Hydro	***1st***	***Bob Welch***	***DPI American Dream***	***Astro #306***
7-Cell Open Hydro	***3rd***	***Jeff Vasquez***	***Electrolite***	***Astro #306***
12-Cell Open Mono	***1st***	***Greg Schweers***	***Black Diamond***	***Astro #305***
12-Cell Open Mono	***2nd***	***Mark Walburn***	***Graupner Monster V***	***Astro #305***
12-Cell Open Hydro	***1st***	***Jeff Vasquez***	***Jeff's Rigger***	***Astro #325***
12-Cell Open Hydro	***3rd***	***Mark Yordy***	***Fastoy's Rigger***	***Astro #325***
12-Cell Sport Hydro	***1st***	***Bruce Mooring***	***D.F. Oberto***	***Astro #325***
12-Cell Sport Hydro	***3rd***	***Ross Hatte***	***Hatte Custom***	***Astro #325***
12-Cell Open Tunnel	***1st***	***David Carriker***	***Schweers Tunnel***	***Astro #305***
12-Cell Open Tunnel	***2nd***	***John Starks***	***Stark's PMP Tunnel***	***Astro #325***
12-Cell Open Tunnel	***3rd***	***Paul Dunlap***	***DPI Tunnel***	***Astro #325***
Anything Goes	***1st***	***Jeff Vasquez***	***Jeff's Rigger***	***Astro #325***
Anything Goes	***2nd***	***Ray Hernandez***	***MRP Fountain***	***Astro #340***
Anything Goes	***3rd***	***Randy Naylor***	***Blew By You***	***Astro #325***

New Super-Hot FIVE TURN Competition Airplane Motors

Astro reveals its new Five Turn Competitio series of Cobalt airplane motors. These motors have been totally redesigned for ***maximum power*** at ***minimum weight.*** The iro field ring that houses the Cobalt magnets has been eliptically machined to remove as much weight as possible *without* sacrificing any magnetic field strength. The machined aluminum endbells have a new open design fo maximum air-cooling and minimum weight. New silver **LAY-DOWN** brushes can safely handle up to 75 amps current draw without sparking and brush life has been greatly increased.

These new Astro Elliptical Motors will ***fly rings around the competition!***



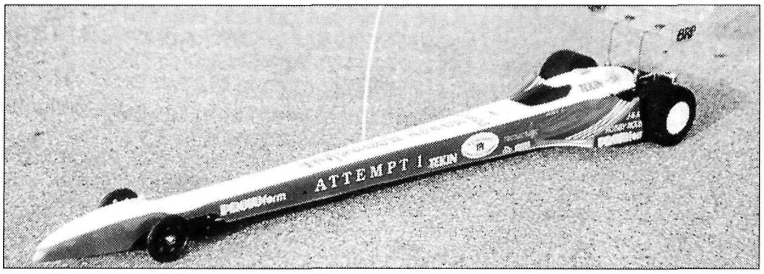
FASTEST R/C Car in the WORLD... 105.6 MPH!

June 12, Sunnyvale, CA.

The R/C Land Speed Record was shattered at the first NCDA Top Fuel Invitational drag race held on June 12 at the NCDA Speedway in Sunnyvale, CA. **Georg Esterer**'s history-making Astro Top Fuel II powered Lightz-ProtoForm dragster became the first wheel-driven R/C car to officially exceed the 100 MPH speed barrier.

George fired his specially-built "Attempt-1" down the 300-foot course and through the dual-backup photocell speed traps at an amazing **105.6 MPH** (105.5 backup)!

In the Drag Racing competition, **Sylvester Grisby**'s Astro-powered *"Fireman"* captured the Top Fuel title, and **Mike Ogle** took top Honors in Top Fuel Unlimited and Low E.T.*(1.84)* with his Astro-powered dragster.



Georg Esterer's Astro Powered "Attempt 1"

For more information, see your hobby dealer or call AstroFlight directly at (310) 821-6242.

COMING SOON:

• The "Electric Motor Handbook" by Bob Boucher...

This all-new book tells you the Why, What, and How of Electric motor theory and practice. This book reveals the secrets of motor building and tells you how to get the most from your motors. The Handbook topics covered include: calculating speed and torque, determining motor constants, timing for sparkless commutation, propeller selection, and gearing. Mechanical drawings and performance curves for all Astro Motors are included. A MUST for the hi-tech racer!

• New Digital Speed Controls

*Astro has joined the digital revolution, and will soon release its first electronic speed controls incorporating its new proprietary **Astro 2001 computer chip**. These new high-rate controls will be smaller in size and lighter in weight, have higher efficiency, and will be **more affordable** than any other digital speed controls now on the market.*

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AIR SCOOP

CHRIS CHIANELLI

New products or people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will, at times, cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!

Right Flyer Revisited

Global Hobby Distributors has just updated its very popular trainer—the Right Flyer 40T. The most noticeable change is the plane's striking, highly visible color scheme—an obvious benefit, especially to novices. In addition, Global has revised the Right Flyer's instruction manual so it's even easier to understand. This should help to further reduce the already short building time. I still receive complaints that manufacturers aren't doing enough to make the hobby more accessible to the masses; well, with this kit, Global really makes getting into R/C flying about as simple as it can be.

For more information on products, contact Global Hobby Distributors, 18480 Bandilier Circle, Fountain Valley, CA 92728-8610; (800) 346-6543.

The Success of a Star

This Star Duster 40 is the latest kit to join Midwest's Success Series. Designed by Mike McConville (pictured), this economical, low-wing sport/trainer features: jig-lock construction and simple wing construction with pre-shaped and notched leading and trailing edges. This all-balsa tail-dragger has a 60-inch wingspan with 665 square inches of area. The weight is estimated at 4½ to 6 pounds, and power recommendations are .32 to .50 2-stroke or .40 to .80 4-stroke. Available in January.

Hitec Guides New Distance Record

Peter Garoni (far right) with his team and members of the Westernport Model Aeroplane Club. Photo taken during trial flights.

Braving Australia's famous Nullabor Plain and the ever-vigilant, very territorial, giant eagles endemic to this region, Peter Garoni and his Australian team recently established a new, nonstop, radio-controlled flight record of 493 kilometers (306.4 miles).

Oh, no! It's the R/C bandits! Actually, the ski masks and goggles were necessary protection against the "Outback" wind during the 6¼-hour, nonstop flight.

Peter designed three identical models, each weighing 6.5 pounds and with 7-foot wingspans. The record-breaking model used a Hitec Prism 7 FM computer radio with Hitec's HS-80 microservos. Backup models used Focus 6 FM radios and HS-80 servos. All three were powered by O.S. Max .46SF engines that were converted to diesel and were swinging 14x8 props at 4,800rpm. The equipment performed flawlessly during the east to west flight from Balladonia to Border Village (no worries, mate). Congratulations to Pete and his teammates.

For Today's Batteries

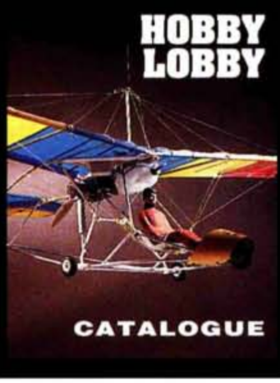
From Hobby-Tec, the company that brought you the easy-to-read System Analysis Meter that measures servo load *(inset)*, here's the new ESV Max. This unit is made for today's Ni-Cd batteries. High-capacity, high-rate, nickel-hydride and standard cells can be tested quickly and accurately. The ESV Max has a "Hi" and "Lo" load switch for 200mA to 2,000mA capacities, a 4- and 5-cell battery switch and a load test button to monitor receiver and transmitter packs with or without a load for *true* readings. The colorful face is easy to read. Made in the USA; one-year warranty; $29.95 plus $3 S&H. Contact Hobby-Tec, P.O. Box 220762, Santa Clarita, CA 91322; (805) 254-4242.

CAN-DO Canopy Glue

Does your canopy eject during high-G maneuvers, suffer from ring-around-the-canopy yellowing, or seem to be in constant need of defrosting, even with the blower on high? The answer?—Canopy Glue! This new product from the boys at Zap promises to be the best canopy adhesive you've ever used, or you get your money back! It's guaranteed to work perfectly every time. Pacer Technology (the manufacturer) claims that lab samples have proven this to be a superior canopy adhesive. It's even better than the old RC-56, which has been discontinued. Tests show Pacer's Formula 560 Canopy Glue works on balsa, plywood, plastics, film coverings, fiberglass and any primed or painted surfaces, and it dries perfectly clear! Yes, the handy 2-ounce bottle does cost a little more, but if it truly solves age-old "modeler-stress" over canopy attachment, as promised by Pacer, then it's worth every cent. Actually, in the grand scheme of things, it may not cost you any more, because you'll probably notice a decrease in antacid expenditures. Canopy Glue (product no. PT-56) is now available at hobby wholesalers and retailers.

Feel like losing yourself in a good book?

I've always found reading Hobby Lobby's catalogue to be one of my favorite modeling pastimes, especially on a cold winter night. It never fails; their catalogues are loaded with unique products. I've been reading them since 1969, and the latest one (pictured here) is the best yet. You can tell it has been written by modelers, not marketeers, and that makes it that much more enjoyable. Like me, I'm sure you'll wear the pages thin by the bedside light. Even if you're not considering a purchase, the Hobby Lobby catalogue is good R/C hobby reading. To order one, call (615) 373-1444. Oh yeah, I almost forgot—IT'S FREE!!



FX35D LOADED WITH INNOVATIONS

Just listen to the innovative names of the features found in Ai/Robotics' new digital FX35D speed controller. The Sequential-Arming-System™ allows you to turn on the receiver and servos to make adjustments and arm the motor—all from the same 0.1-ounce, easy-to-mount mini-switch. On power-up, Throttle-Lock™ prevents the motor from pulsing, and a smart LED constantly displays the condition of the system. The In-Flight Charger™ (for non-BEC users) charges a small receiver battery pack in flight! The Power-Management-Shutdown™ circuit extends flight times, and the Quick-Start™ throttle mode gives a fast response in the heat of competition. Add to all that the Adaptive Frame Tracking™—a super-smart, anti-glitch system that detects when someone turns on a transmitter on the frequency you're using, and you've got one very advanced speed controller. But wait, there's more! According to the manufacturer, this is the only controller ever made that can survive with its output wires indefinitely shorted out. It's designed for 6 to 20 cells (50 amps). For more information, send an SASE to Ai/Robotics, P.O. Box 8207, Mission Hills, CA 91346.

PILOT PROJECTS

A LOOK AT WHAT OUR READERS ARE DOING

SEND IN YOUR SNAPSHOTS

Model Airplane News is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable.

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of 1995. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.

SCRATCH-BUILT SKYRAIDER

Charles Armand of Alexandria, LA, sent this photo of his large, 90-inch-span, scratch-built A1-H Skyraider. Featuring built-up construction and sheeted with 3/32-inch-thick balsa, the 19-pound raider is powered by a Quadra 42 that spins an 18x8-14 prop. Additional touches include Robart retracts and a bomb release. Charles painted his pride and joy using Randolph Aircraft butyrate dope.

"KING"-SIZE SUKHOI

John Albano of Saddle Brook, NJ, reports that the King is still with us, and he digs aerobatics as much as jelly doughnuts! Shown is Albano's Carl Goldberg Sukhoi with an O.S. 120 4-stroke; Coverite's 21st Century fabric and paint; and, of course, "Tiny E." John has been into R/C flying for about 10 years and just can't get enough; he especially loves aerobatics and says that his Sukhoi is "just the ticket." Thank you, thank you very much.

CARRY A BIG STICK!

Pictured are Norris Hill (left) and David Young (right), both F-15 crew chiefs in the USAF stationed at Kadens AFB in Okinawa, Japan. Norris and David are avid R/C fliers and are shown holding their modified, straight-wing, Great Planes Big Stik 60s. The "twin" planes are each powered by Saito 80s and are covered with Top Flite metallic MonoKote. David also informs us that he's a *Model Airplane News* fan and especially enjoys Dave Patrick's "Aerobatics Made Easy" column.

FLEMING'S SUPER CUB

This big, 1/3-scale Piper PA-18 Super Cub is the handiwork of Dean Fleming and his father, Percy. The Flemings, who live in Mineville, NY, say that the Cub is a modified version of a Balsa USA kit designed to resemble the new, full-size Super Cub. Power is provided by an equally large Zenoah G-62 swinging a 22x8 prop. Features include fully operational flaps; landing lights in the leading edge; navigational lights; and a full IFR cockpit with pilot. The Cub is covered with Super Coverite and painted with automotive acrylic enamel.

PILOT PROJECTS

MONSTER MR. MULLIGAN

Don Trammel of Sebring, FL, built this great Mr. Mulligan from a Bud Nosen kit in only 4 months. The 108-inch model is covered with painted Coverite, and it's powered by a Quadra 42 gas engine. Don is the president of the Highlands County R/C Club, and he says that the old-time racer looks so authentic while flying that cars stop on the nearby road to watch it. The model is controlled by a Futaba 7UAP radio.

BRUNO'S BELGIUM ULTIMATE

Bruno Vantournhout of Opwijk, Belgium, built this mini Ultimate from French RCM (*Radio Commande Magazine*) plans, and he powers it with an O.S. .48 4-stroke Surpass engine. The model has a 39-inch wingspan and weighs 4.6 pounds. It's covered with MonoKote, and the wheel pants and engine cowl are made out of fiberglass and epoxy resin. Bruno says that the model (designed by Gilles Descroix) is the best he has ever flown; it's fast, stable, and it lands easily. Aerobatics include everything in the book.

NICE NIEUPORT

Bradley Lewis of Wilton, CT, built this Proctor (VK) ⅙-scale Nieuport Type 17 and powers it with an O.S. .70 Surpass engine. The model has a 54-inch wingspan, and it's controlled by a Futaba radio. Details include a William Bros. pilot, wheels and machine guns. Bradley, proprietor of Heritage Hobbies, says the model flies well, but it's a handful to land.

SCRATCH P-61-B NIGHT FLIER

This stunning replica of P-61-B no. 38237 of the 44th Night Fighter squadron is the work of Roger Brennom of Dunedin, FL. Roger scratch-built the plane using Styrofoam covered with balsa sheeting and epoxy-resin-impregnated, polyester fabric. Some of the incredible details include hand-formed canopies and rear bubble; handmade cowls and spinners; and modified Du-Bro wheels with aluminum hubs. The 102-inch-span plane also features twin O.S. 108s; modified electric retracts with working gear doors; four-section, proportional flaps; complete panel lines and rivets; and more.

CONSTRUCTION

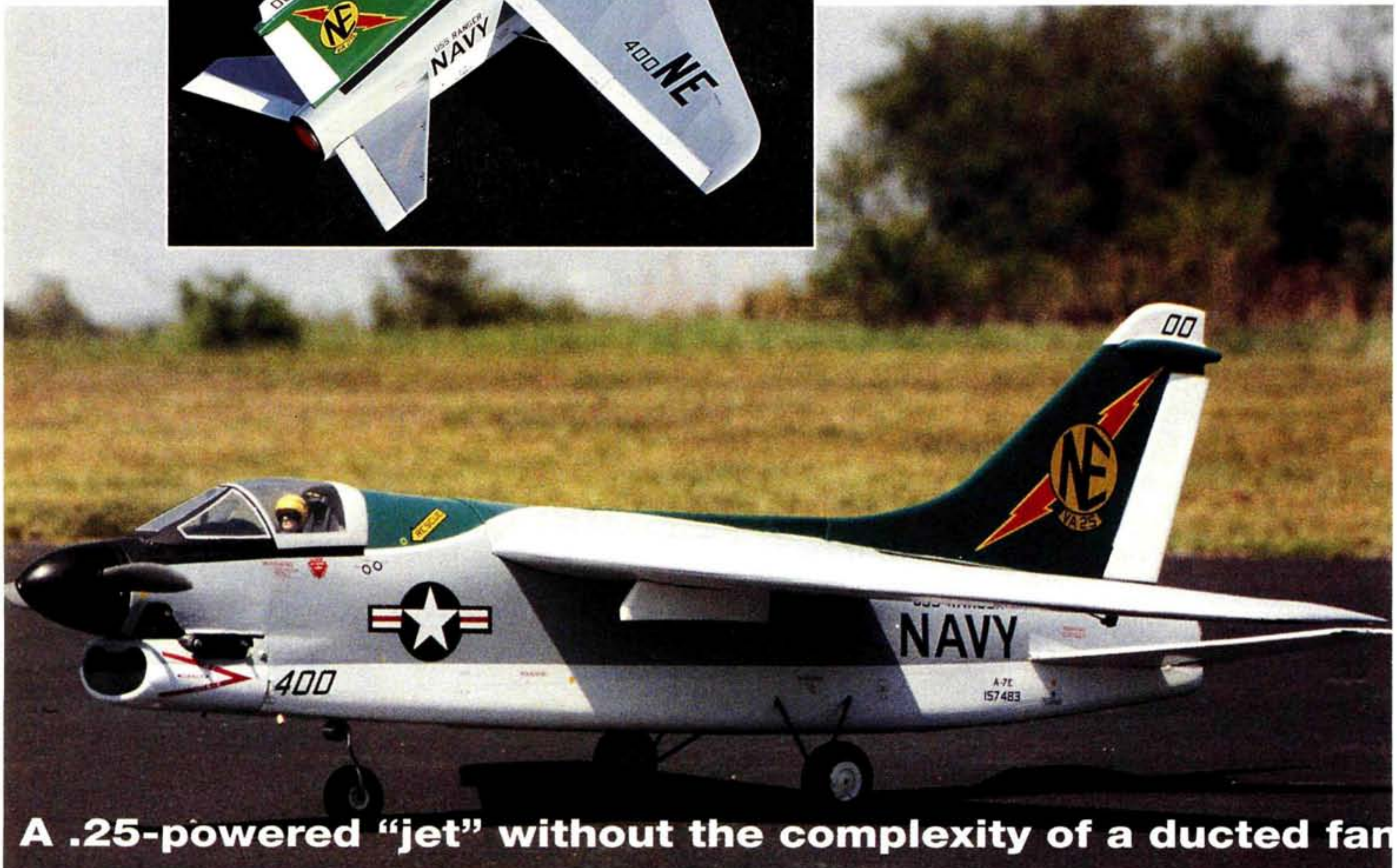
by RICH URAVITCH

LTV A-7 CORSAIR II

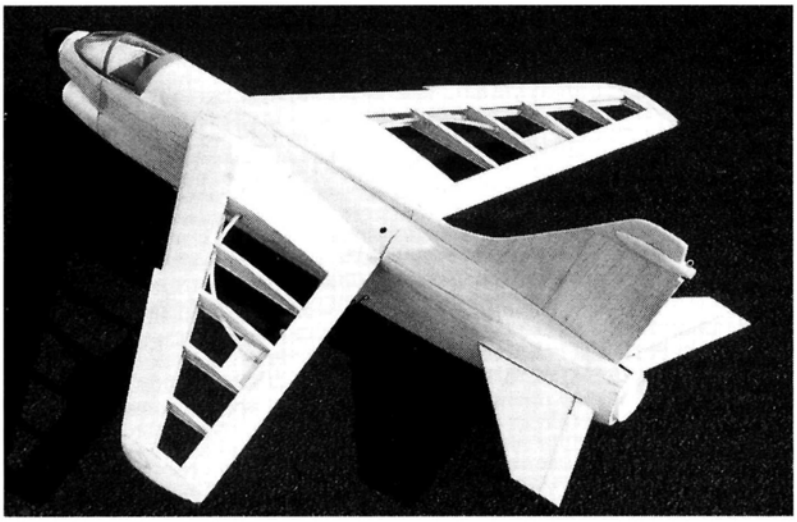
Prolific designer Rich Uravitch shows off his latest creation.

WHEN I DECIDE to design an R/C model—at least, one that I'd like to see published—I consider a number of things. Most important, it must be a subject on which I'm prepared to spend the time required to design and build. Second—and almost as important to me—is that it appeal to as broad a range of modelers as possible. (That makes it easier to convince the magazine folks that their readers will love it and, naturally, continue to read future issues of the magazine in anticipation of similar material.) The A-7 presented here certainly satisfies requirement one, and I hope, number two.

The popularity of my little Extra 3.25 (Air Age Publishing plan no. FSP01931) reinforced my feeling that a lot of you out there really do enjoy the benefits of building and flying .25-powered, sport-scale airplanes that deliver excellent performance without blowing the



A .25-powered "jet" without the complexity of a ducted fan



The framed-up SLUF before final sanding and covering.

budget. Further evidence of the interest in smaller airplanes is the growing attendance at the annual Small Steps Fly-Ins in Dallas, TX, and Little Rock, AK. Virtually all the models flying at these two meets are .25-powered (or less!). Although I haven't, as yet, attended either of these gatherings, folks who have, tell me that when you do, you're hooked!

SPECIFICATIONS
Name: A-7 Corsair II
Length: 36.75 in.
Wingspan: 35.5 in.
Wing area: 327 sq. in.
Weight: 3.5 to 4 lb.
Wing loading: 24.8-28.4 oz. per sq. ft.
Power req'd: .25 to .28 2-stroke
No. of channels req'd: 4

Like a lot of you, I read all the R/C magazines I can get my hands on—for the same reasons you do: entertainment and information. What's happening? Who's doing it? What are they flying? What's new and different?—questions for which we'd all like answers. A couple of trends seem to be emerging (to me, anyway): more and more modelers prefer designs that *look* more like *real* airplanes. When you get past the basic trainer stage (whose airframes, through necessity, have to look like they do), there shouldn't be a real reason to build or fly anything that doesn't at least *resemble* a full-scale airplane.

Kit manufacturers have recognized this, and many are responding. Take this one level further: models that look like jets now have a broader appeal simply because—hold on to your transmitter—this is the jet age. Why do you think that some of the more popular kits being sold today look like jets? Because they're new, exciting and look great! Enough about philosophy; let's talk about building *your* A-7!

BEFORE YOU START

Before you start hacking up balsa, I'll point out a few things that you should know about the design. If you've built a number of kits and, perhaps, one or two "scratch-built" designs from plans, you'll have absolutely no problem building this model; in fact, it's easy enough to be your first *scratch-built* R/C airplane. Unfortunately, I can't recommend it as your first R/C model or trainer because of its size, for one thing. The attribute that makes it appealing is what will get newcomers into trouble: small, warbird or jet-type models generally have higher performance

SLUF—Super Little Unsung Flier?

At first glance, it might appear that the A-7 Corsair II is the result of a bad carrier landing with an F-8 Crusader—one that caused a significant reduction in length! Somé power must have been lost also, because what was once a hot, supersonic Navy fighter has now gone sub-Mach as an attack airplane. Contrary to appearances, the A-7, nicknamed the "SLUF*," *wasn't* an attempt to use leftover F-8 spare parts when the Crusader production line came to an end. The A-7 *was*, however, an all-new, multi-service airplane that eventually provided its user with a deadly accurate weapons-delivery capability never before seen in an attack airplane.

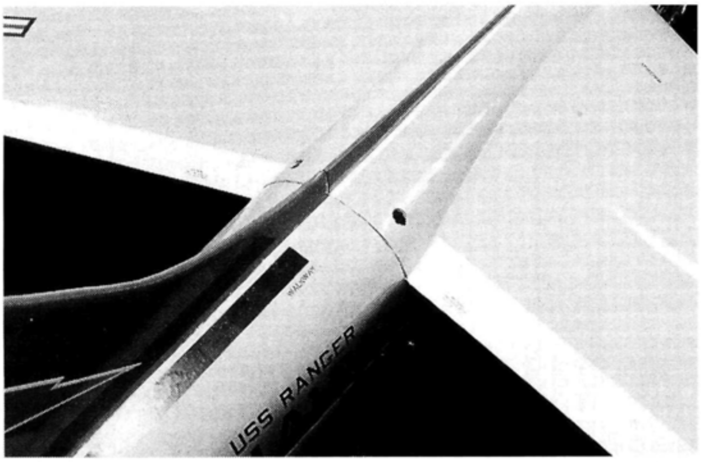
The A-7 can trace its lineage back to the Vought VE-7—a 1917 vintage biplane that made the very first carrier takeoff from the very first Navy carrier (USS Langley) on October 22,1922. The first Corsair, although it was never "officially" named, was Vought's O2U-1 (1926), and it was followed by the 1940-era F4U bent-wing bird that warbird enthusiasts have come to know and love.

The A-7 first flew in 1965—10 years after the F-8 broke ground for the first time. Since that time, 1,551 A-7s were produced in nine variants—serving with the U.S. as well as with foreign air forces and navies. More than two-thirds of the production run were "D" and "E" models that performed yeoman's service in the confrontations history records as Viet Nam, Grenada and Beirut. The ones *not* lost in combat returned to serve on until being replaced by A-10s and F/A-18s.

Clear evidence that the basic soundness of a design sometimes *does* come full circle was demonstrated when the prototype Super Corsair, or Corsair III, emerged from LTV's hangars. Some of the length lost from the F-8 was recovered—3 feet of it anyway—and so was a supersonic capability, which was provided by the new G.E. F110 turbo-fan engine. This extensive upgrade was proposed for the A-7s serving with the Air National Guard, but, ultimately, it was not cost-effective enough to pursue.

Few A-7s remain in service today; they perform specialized duties such as flying test "chase" missions at the AF Flight Test Center; support and training simulation missions for the formerly secret F-117A; and ECM sorties with Navy recce outfits. A long career? Certainly. A distinguished career? No question. Only the legendary F-4 Phantom was in as widespread use with both the Air Force and Navy at the same time, and its place in the history of aerial warfare is assured. So it should be for the SLUF!

SLUF: a term of endearment for the LTV A-7 meaning "Short Little Ugly F——."



Wing hold-down area. Stenciling and markings are available from Dry-Set.

capabilities and higher wing loadings that take them well out of the trainer category. The A-7 is typical of the breed. If I haven't frightened you off and you're ready to take up the challenge, clear the bench!

To make building your Corsair as easy as possible, we've decided to present the construction sequence in the same way as we did the Extra 3.25—as a step-by-step sequence, much like many of the more successful kits are presented. This sequence, used with the notes on the full-size plan, should make building your A-7 an enjoyable undertaking rather than an exercise in frustration.

To cut down on some of your building and carving time, I am making available a vacuum-formed set of parts for this design. The package consists of a clear canopy, and high-impact plastic parts for the cowling, jet exhaust nozzle, and air-refueling receptacle fairing as used on the Air Force A-7D variant. Cost of the package, including shipping, is $19.95 and may be obtained from me directly.

All the tail group parts are cut out of medium 3/16-inch balsa and then sanded to final shape. Refer to the plan for grain orientation and control-linkage installation. Don't forget the hardwood block on the top of the horizontal stabilizer halves; it provides bearing support for the rudder linkage.

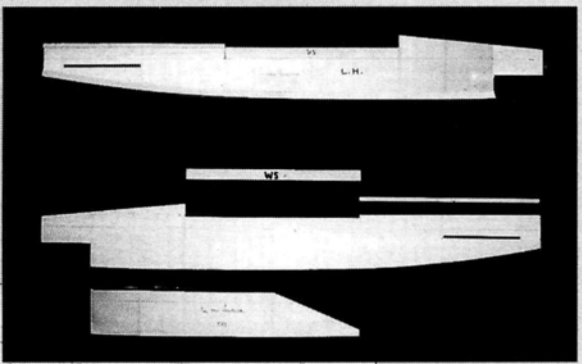
ENGINE INSTALLATION

The A-7 will accommodate a variety of engines from .19 through .28 in displacement. The prototypes used an O.S.* .28 and a Magnum* .25, and the performance was terrific. For you speed freaks who are already considering stuffing a .40 into the engine compartment, I suggest that you forget it! Though the additional power might enable you to put your version of the A-7 into orbit, the additional weight of the .40 will require a huge amount of compensating weight *in the tail,* and that will push the wing loading right up there next to the brick we've all heard about! Stick with the recommended engines; you won't be disappointed!

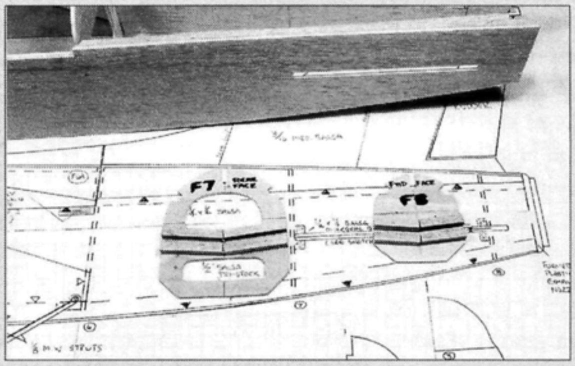
RADIO INSTALLATION

See all that empty space below the wing between bulkheads F4 and F6?—the space where your radio would normally go? Well, that's the way it's going to look forever, because nearly all of the A-7's radio equipment goes *behind* F6. Even with all the radio equipment as far aft as you can get it, you'll probably have to add ballast (dead weight) to the tail. For this reason, I suggest that you don't close off the end of the fuselage with the jet nozzle until you've com-

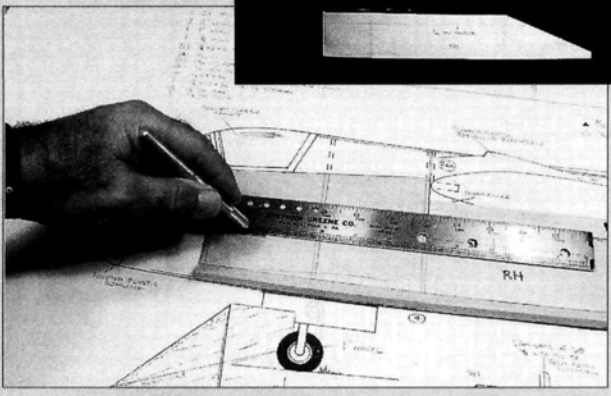
FUSELAGE BUILDING SEQUENCE



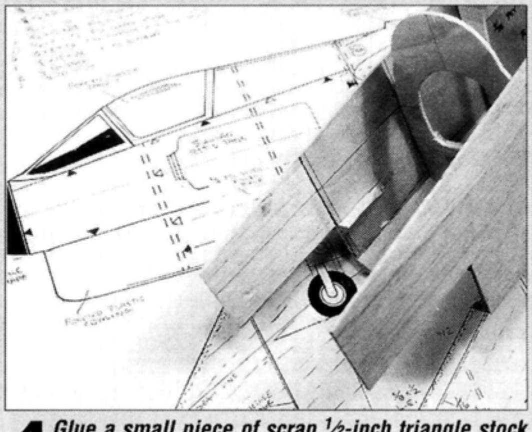
***1** The basic fuselage sides, showing right-hand parts and (top) completed left-hand sub-assembly. Half-inch balsa triangle stock is used along length of lower edge.*



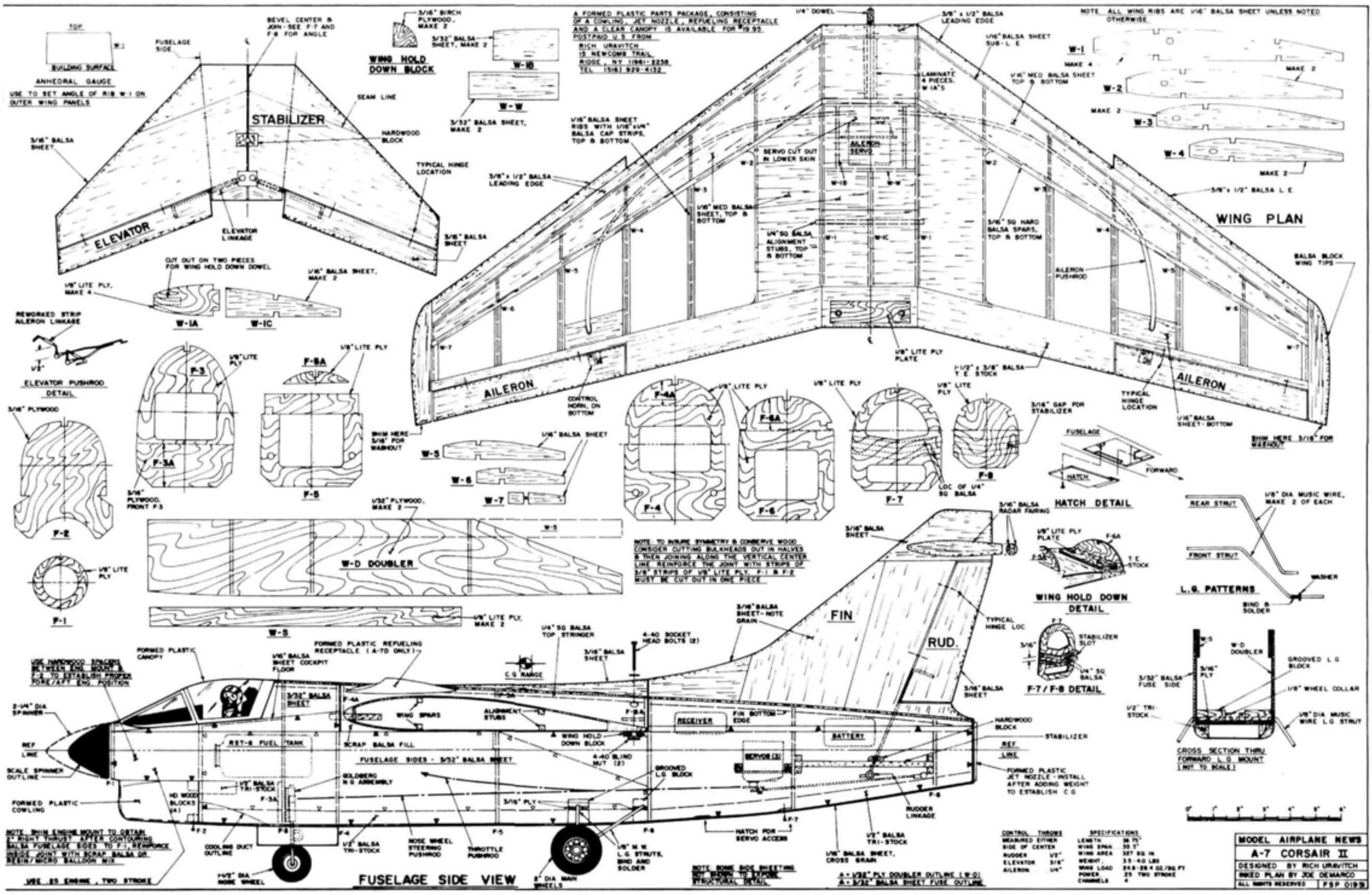
***3** Above: prepare bulkheads F7 and F8 by adding 1/4x1/4-inch balsa guides to the rear face of F7 and the forward face of F8. These establish both a gluing platform and a dihedral angle for the horizontal-stabilizer halves. Make sure the gap between the guides is 3/16 inch to accept the stabilizer.*



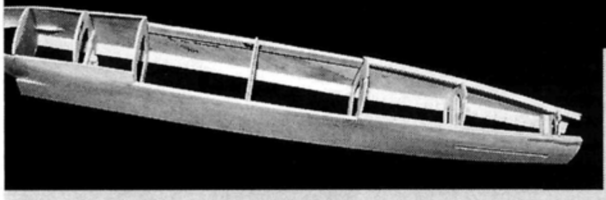
***2** To make it easier to contour the forward end of the fuselage, cut completely through the fuselage side from a point that's midway between bulkheads F2 and F3 to the forward edge of the fuselage side. Mark the bulkhead locations directly on the fuselage side, and install bulkheads F2 through F6. Use a triangle to ensure they're square.*



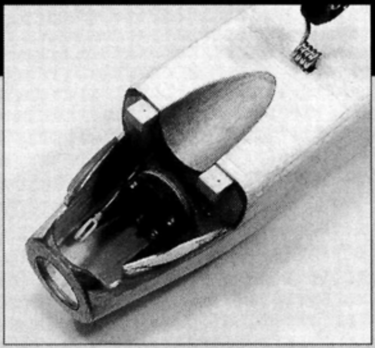
***4** Glue a small piece of scrap 1/2-inch triangle stock below the cut you made in the fuselage side.*



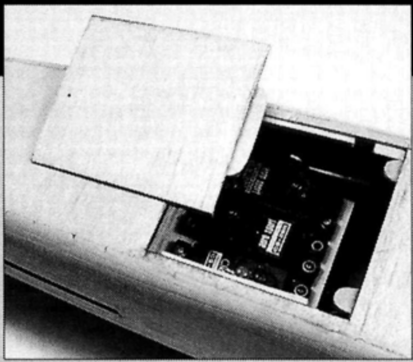
ORDER THE FULL-SIZE PLANS...SEE THE PLANS DIRECTORY—PAGE 81



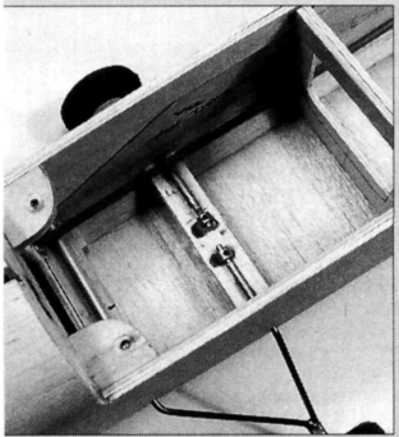
***5** This is what your fuselage should look like before you add the upper and lower sheeting. Elevator linkage is short, uses ball-link connectors (detail shown on plan). Servo access is through a removable hatch.*



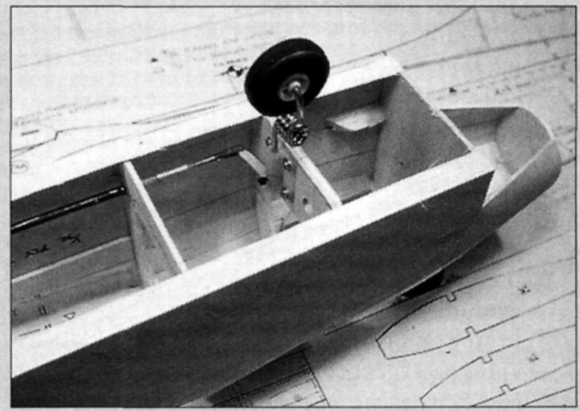
***8** The engine compartment, showing mount, cowl, hold-down blocks and engine-cooling "trough."*



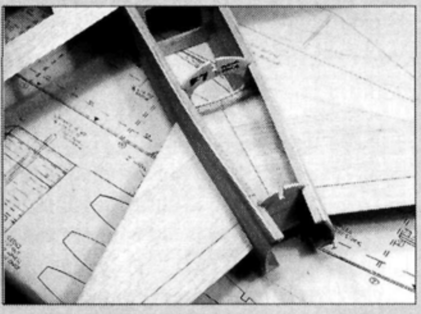
***9** The removable hatch in the lower aft fuselage provides access to three servos and linkages. A single no. 2 screw holds it securely.*



***6** The main landing-gear assemblies are removable. They're plugged into brass tubes and are retained by wheel collars on the forward struts. Although it's a little more work, it makes it easier to cover and finish the model.*

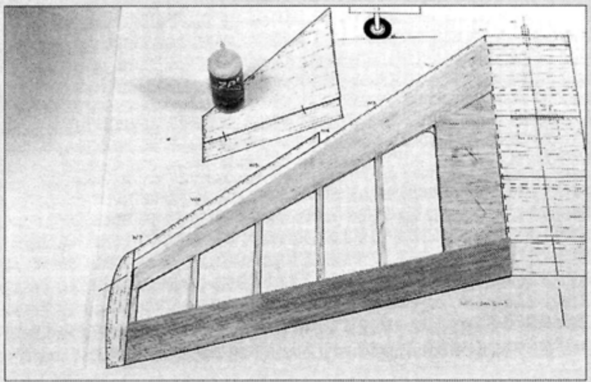


***7** The nose-gear installation, showing the steering-linkage path. Throttle-linkage routing is similar, but on the opposite side of the fuselage.*

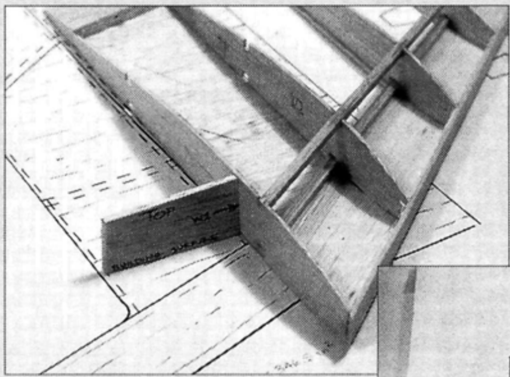


***10** The aft end of the fuselage with the stabilizers and elevators installed. Upper sheeting has yet to be added.*

WING BUILDING SEQUENCE

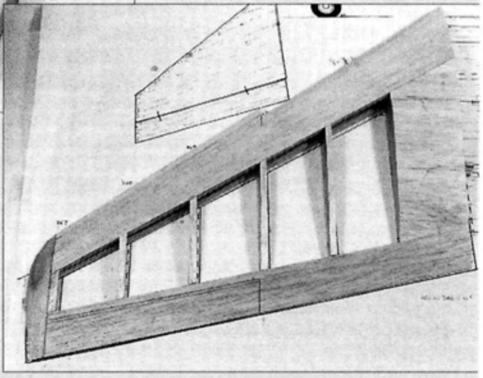


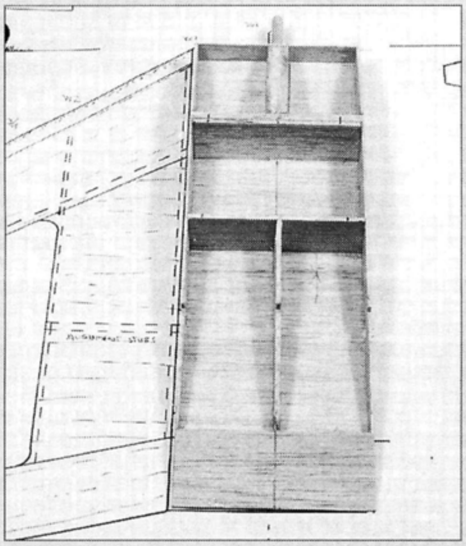
1 *After covering the plan with a sheet of clear film or wax paper, pin the trailing-edge stock, sheeting and capstrips into position. Apply glue to all seams and joints. Glue the lower 3/16x3/16-inch hard-balsa spar into position, followed by ribs W2 through W7. Make certain the ribs are perpendicular to the building surface. Do not glue rib W-1 into place at this time. Pin the forward end of rib W7 to the building surface, and add the upper spar and the 1/16-inch balsa sub-leading edge. Position a piece of 3/16-inch balsa behind rib W7 as shown. This is a temporary shim that will automatically build the required washout into the wing panel.*



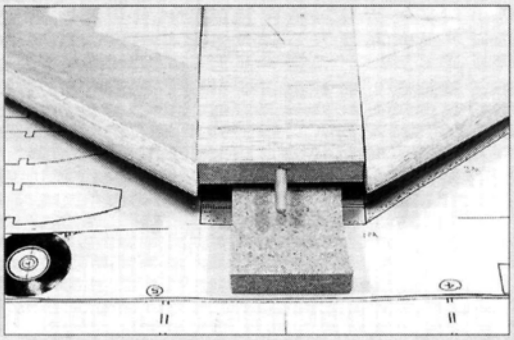
2 *Glue rib W1 into position using the anhedral gauge to establish proper angle. Remember, the wing has anhedral, so the top of the rib leans slightly inboard rather than outboard as with dihedral.*

3 *Add all the upper sheeting, the capstrips tip block and the leading-edge pieces, including the additional 3/16x1/2-inch balsa piece that creates the leading-edge "sawtooth." Carve the leading edge to shape, and final-sand the wing panel to smooth all the seams and glue joints. Build the right-hand wing panel in the same way.*

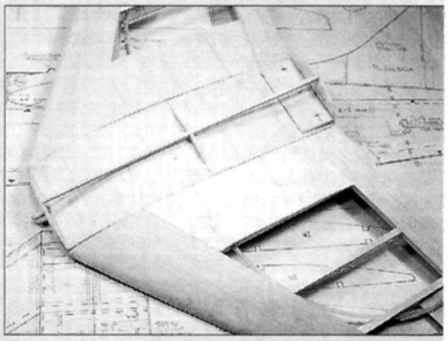




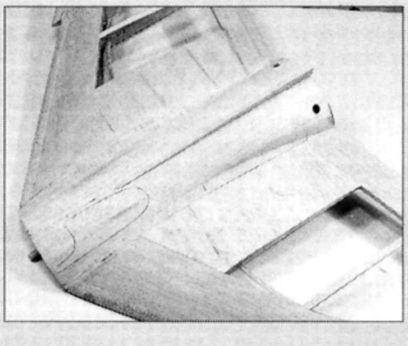
4 *The wing center section is built over the plan and consists of W1, W1A, W1B, W1C and WW parts along with the trailing-edge stock and sheeting. The 3/16x3/16-inch "alignment stubs" have not yet been installed.*



5 *Above: to help maintain the proper anhedral angle when the outer panels are joined to the center section, place the center section on a piece of 3/4-inch material (flake-board shown), attach the outer panels, allowing the leading edge, at the wingtip, to contact the building surface. Don't forget to preserve the washout you've built in!*



6 *Above: bulkheads F4B through F6B installed on the completed wing; center stringer supports sheeting.*



7 *After the wing panels have been joined, and the wing hold-down provisions are incorporated; add bulkheads F4A through F6A, the upper stringer and the balsa sheeting.*

pleted all the CG and balance checks. Nosegear steering and throttle pushrods extend forward and should be anchored securely at each bulkhead.

COVERING

I chose light gray MonoKote* to cover the prototypes because it's a reasonable approximation of the shade used on U.S. Navy A-7s. Sticking to my allegiances by doing an Air Force A-7D would have meant painting a camouflage scheme, which I had considered, but Mike Anderson of Dry-Set Model Markings* offered to make a set of colorful Navy insignias, including all that neat little stenciling that's so hard to duplicate.

Shortly after sending him some drawings of what I needed, I received a package that included all the markings you see in the pictures. These packages are now for sale; check with Dry-Set for the current prices.

Formed-plastic exhaust nozzle position. Piece of orange MonoKote used to create impression of hot engine "flame."

The "office" area. Note extensive stenciling, placards and markings—all available as an A-7 set especially made for this model by Dry-Set. Pilot figure is a reworked Williams Bros.* item. Keep gap between spinner and F1 to a minimum to enhance the "jet" illusion.

Dry-Set markings, like many others, are of the rub-on type. Unlike most others, however, the material used is *paint* rather than Mylar film, and that's what makes it possible to duplicate all that, itty-bitty lettering (of the *proper* type-face) for all that stenciling. They don't require clear-coating for fuel-proofing either—another plus.

FINAL COUNTDOWN

So, there it is—the project you've toiled over for at least 8 hours. Now add the spinner, pilot figure, wheels, canopy and whatever else you think it needs. Check the CG again, along with the lateral balance, and verify the control throws as indicated on the plan. Be particularly aware of the aileron deflection values; aileron sensitivity is such that it doesn't take much to roll the airplane. Also be certain that the aileron linkage is slop-free and that the surfaces return to neutral when stick pressure is released; if they don't, you'll be fighting the ailerons and probably overcorrecting throughout the flight—as we were!

Put everything on charge, including your field-box batteries, and wait for a test-hop day to arrive.

CLEARED TO LAUNCH!

It had to happen, didn't it? No way to avoid it! Inevitable! The day is perfect and you head for the field to find just a hint of a breeze right down the runway. You fire up the engine, settle it down to a perfect idle, take the active and, in about 50 feet, your Corsair II is airborne, with *no* trim required.

Every maneuver you've ever thought about comes easily, and you line up on final, touch down right on the numbers and taxi back to the rousing applause of fellow club members who had come to witness the historic event. ESPN requests an interview, and you're on the evening news. You've arrived!

And I hope the first flight of *your* A-7 goes exactly that way; mine, however, was a *little* different! The first time my model had light under its wheels and wind beneath its wings, it was in the skilled hands of Nick Ziroli Jr. It was a 20-second excursion into terror that clearly indicated that I had way too much throw in the ailerons; they weren't centering properly, and the .28 in the nose could have used some right thrust. Everything else was probably perfect!

Returning to the workshop, thankful I still had an airplane, I made all the necessary changes and, a couple of days later, headed for the field once again. This time, everything *did* work! The little *sluf* was all that I expected it would be—plus a little more. It zips along at a pretty good clip with the now-invisible prop enhancing the jet illusion. It's a lot of fun to fly and always gets attention from other modelers. Its slow-flight qualities are excellent and become especially evident on final approach where you really can "drag" it in to touchdown.

If you've been caught up in this whole "jet" thing and prefer smaller airplanes that deliver great performance, give the A-7 a try; it's an inexpensive, fun-filled alternative to some of the larger higher-powered models. If smaller (.25-powered) models have captured your heart, interest, or both (as they have mine), stick around; there's more where the Extra 3.25 and the A-7 came from. How about a twin .20-powered N.A. Rockwell OV-10 Bronco? Stay tuned...!

**Addresses are listed in the Index of Manufacturers on page 177.* ■

PROFILE HOTS SERIES

Since last months ad was written we have flown the ***SU-do-KHOI*** more and more and are finding it doing more and more. We were pleased when we found it would do a knife edge loop, we were overjoyed when we found it would do consecutive knife edge loops and were ecstatic when we found it would do consecutive tight square knife edge loops. I was also suprised to see it take off and do a carrier landing on a picnic table. The double lomcevacs and wing tip spins and inverted and regular flat spins are becoming routine. Horizontal figure of eights in the hover altitude three feet off the ground are getting easier when there is no wind but still tough in wind. When mated with the MVVS 40, it does all the maneuvers that the ***Profile Hots*** does. Hold it in you hand and release it for an up and out of sight. Take it off in three feet, turn it straight up, stop at ten feet, hang as long as you like then do a tail slide. When the tail touches, back up to ten feet, then do another tail slide but this time after the tail touches it drops forward for landing on the wheels. Feel daring? Come out of a flat spin at three feet and land at you feet. Master it and you are among the best.

These planes were designed for use with the MVVS 40, the most responsive 40 I have ever seen. This responsiveness is very helpful in the hovering maneuvers. It is very powerful - pulling a 10 x 5 APC prop 15,800 RPM's. It's all on tape!

Either tape is $10.00 or both for $17.50. Make a copy and return the tape for credit on your next order. The ***Profile Hots*** kit is $64.95 and the ***SU-do-KHOI*** is $79.95 The Combo includes the engine and tuned silencer: $194.95 for the ***Profile Hots*** and $209.95 for the ***SU-do-KHOI***. Shipping and handling add $5.45; VISA and MasterCard accepted; Air & International orders extra. Call Morris Hobbies today at 1-800-826-6054, (502) 451-0901 or FAX at (502) 451-6602. Can't get through? Call 1-800-468-3867 Home Access #423 (evenings and weekends).

MORRIS HOBBIES

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▶ VA (RUSSIAN) ENGINES	
.049 Racing Engine	49.95
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.15 ABC RC DBB		72.99
.15 GLOW ABC DBB w/VENTURI		57.89
.15 DIESEL w/VENTURI		57.96
.21 ABC RC DBB		82.99
.21 CAR-ENGINE DBB		112.99
.40 PYLON DBB		130.99

.40 ABC RC DBB	103.7
.40 Q500 SIDE-EXHAUST w/muffler	199.9
.52 U CONTROL DBB	149.9
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.25 RC BB SCHNUERLE with Muffler	58.6
▶ MOKI ENGINES	
.15 ABC Racing Model	102.9
.15 Sport Model	54.0
.15 Sport RC BB	78.0
.61 LS ABC-Ring	163.2
.61 LS ABC	163.2
.61 Rear Exhaust	154.9
.61 Glow with Diesel Head	199.0
1.80 Ring	259.9
.51 RC Front Rotor Ring	151.2
3.6 Inline Twin	550.8
Moki Marine .40	185.8
Moki Marine .90 ABC	293.9
▶ K & B ENGINES	
20 RC Sportster	47.5
40 RC	66.7
45 RC (FAN)	139.4
61 RC	78.9

sig WONDER

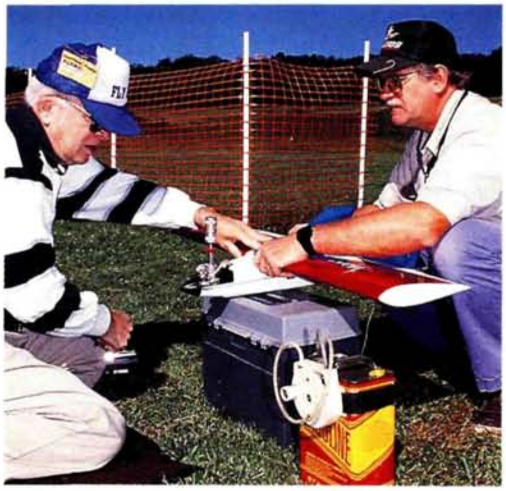
by BOB GILBERT

A docile, almost all-wing hybrid

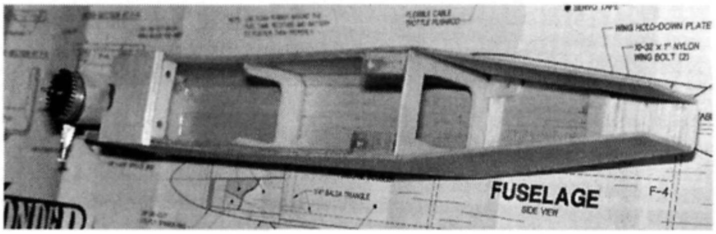
THE SIG WONDER has been a winner for me from the time I saw it in an ad. Its design was appealing, and I was ready for another small, "almost all-wing" airplane. With its 37½-inch wingspan, the Wonder is a combat-style airplane designed for .09- to .19-size engines.*

One of my previous projects had been a combat-type, all-wing design. It flew, but it was much too hot for me. I crashed it too often and too soon. Unlike a traditional flying wing, the Wonder has a fuselage, which provides space for the radio and fuel tank. The large stabilizer, while attached directly to the wing's trailing edge, still locates the elevator substantially aft when compared to all-wing combat designs. This would make the plane more stable.

Although I've had the pleasure of flying many of Sig's airplanes, I have never, ever, built one, so this was to be my first.



The author (left) fires up the Wonder with the assistance of fellow FLYRC club member Ken De Fusco.



The Wonder's fuselage provides ample room for mounting the fuel tank and the control system. Its built-up balsa-and-ply construction makes it durable and easy to build.

CONSTRUCTION

The Wonder is a small airplane, it comes in a small box, and it has a small price. All the parts were neatly packed, and no damage had occurred during transportation. I spotted four sheets of decals, all of which were different. I like this! I looked at the 20-page instruction book right away. I start at the back (don't we all?) and found that the plans show four different versions: Standard, Russian, Angel and Patriot. I chose the standard version, but I used standard wingtips rather than the vortex type shown on the plan. I also used my own color scheme that included transparent covering for the wings.

The Wonder is simple and straightforward, with conventional, built-up balsa construction for the wing and the fuselage. Building this kit was a dream. There were no missing parts, and they all fit well. The sequences outlined made sense and produced a completely framed-up airplane in only a few evenings. Not having to make things like the wing center section and the landing gear also helped. The instruction book is well-illustrated, and the plans are first class, but I would have preferred rolled rather than folded plans.

The instruction book goes into some explanation as to why things are done the way they are. This made the instruction manual a little more readable than most, and I learned a few things. I found only *one* minor mistake. Instruction number 11 states that the Wonder airfoil is symmetrical, which, indeed, it is, and they advise that either side can be used as the top. This is not correct. The lower half of the wing structure contains the wing dowel supports (WDS); the upper half does not. Therefore, keep track of which is the upper half until you have installed your wing dowels.

If you follow the instructions, the building will be fun, for there are no dead-end instructions that leave you wondering which way to turn. Over the past 45 years, I have built many kits, and I can assure you that the plans and instructions in this kit are among the best I've seen.

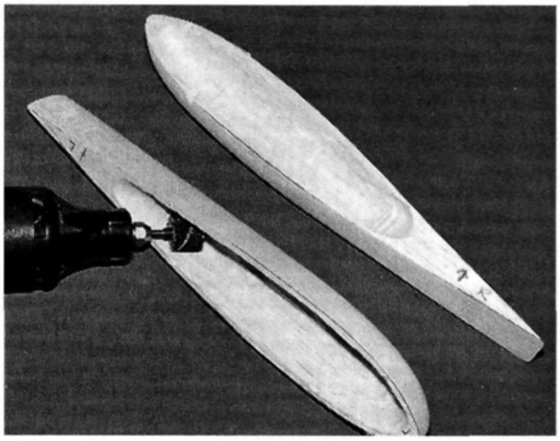
POWERPLANT

For power I chose an O.S.* .10. Although this engine is at the lower end of the recommended power range, I wanted the flight characteristics to be much more docile than the last "wing thing" I had flown. I used the glass-filled engine mount supplied and rounded off the front with a 1¾-inch-diameter, black plastic spinner, and I used a 4-ounce fuel tank. To balance the airplane, I placed the battery near the rear of the fuselage with the receiver just aft of the tank.


Although the O.S. .10 is at the lower end of the recommended power range, it provides adequate flight performance.

RADIO

If you use smaller-than-standard servos in the Wonder, which Sig recommends, the radio installation will be a breeze. I used a micro-size servo for the throttle and a mini-size servo for the elevator and ailerons. Also, as recommended, I used a 250mAh battery. When complete, my Wonder weighed 30 ounces, which is in the range of 26 to 38 ounces called for on the plans.


PHOTOS BY WALTER SIDAS & BOB GILBERT

The author used standard wingtips in place of the vortex type shown on the plan. Here, the tips are being lightened using a Dremel tool and a grinding bit.

COVERING

I followed the building sequence very carefully, but when it came to the covering, I just had to let myself go a little. Although I built the Standard version, my covering was more like that of the Patriot, using red, white and blue. The basic fuselage, stab and elevator are covered in opaque white. The wings are transparent red with white tips. The canopy and fins are done in trans-

FLIGHT PERFORMANCE

• Takeoff and landing
All takeoffs are hand launches, but this little plane is easier than most because it has a fuselage that you can hold on to. This enhances safety. Even with a .10-size engine, only a gentle toss is required. Landings are always on the belly skid and, in an effort to save the prop, it's best to stop the engine prior to touchdown. If you have high grass at the side of the runway, landing in that may save you a few props.

• High-speed performance and aerobatics
The large tail planes make this airplane track beautifully. High-speed low passes over the far side of the field were easy to accomplish. It rolls axially. Loops at full throttle and full elevator throw were very small, and large loops were also possible. I could see no way to do a spin, as there is no rudder. This lack of rudder limits aerobatics capability, but not the fun. Inverted flight requires little correction. With the small engine, vertical performance is limited, but with more power it should have the right stuff for combat flying. (I'll try that soon).

• Low-speed performance
The best test of low-speed performance I had was during landings. In all cases, I'd kill the power and then glide it in, slowing it to a stall just before touchdown. It never had a tendency to drop a wing, and it's very easy to fly at all speeds.

The instructions state that either side of the fully symmetrical wing can be used as the top; this is not the case because only the lower half of the wing contains the wing-dowel supports.

This little airplane is great fun. It was fun to build, and it is lots of fun to fly. In a word, it's *Wonderful*.

parent blue. Adding the supplied decals really finished the job nicely.

TIME TO FLY

At last, a nice day! The sun was out, and there was a light breeze. Having charged the batteries the day before, I checked them again at the field. As we have had a recent rash of reversed controls at the field, I had someone else check mine again. Balance and control throws were double checked, and the engine was tested thoroughly for the first flight.

I enlisted my friend Dave Miles to help with hand-launches and camera operations. My first flight was about as harrowing an experience as I have had in some time. The airplane was so sensitive in pitch that I could barely control it. Having used full throttle at launch, I cut back the power, and that calmed the beast somewhat. We made a few low passes to take photos, and then landed to see what could be done about the sensitivity in pitch.

The balance was checked against that shown on the plans, and it was correct. The only thing we could do was reduce elevator throw by moving the pushrod to the outermost hole on the control horn. Then we refueled and went off for flight number two. Aha! The Wonder flew much better, and I let Dave take the controls for a while. Dave and I both agreed that while the plane was still a little sensitive in pitch, we both liked it that way, and we proceeded with the maneuvers required to assess the flight performance.

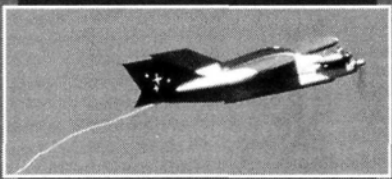
At home, I decided to look at the elevator throw again. Guess what? It was still somewhat more than the plus or minus ¼ inch called for on the plans. To achieve the correct throw setting, I moved the pushrod clevis closer to the pivot on the servo. Subsequent flights were much gentler and to my liking. In this case, the plans were correct, and I had somehow made a mistake in the setup, even though I had checked it more than once.

This little airplane is great fun. It was fun to build, and it is lots of fun to fly. In a word, it's *Wonderful*.

**Addresses are listed alphabetically in the Index of Manufacturers on page 177.* ■

SPECIFICATIONS

Model name: Wonder
Type: Sport/combat
Manufacturer: Sig Mfg. Co.
List price: $39.95
Wingspan: 37½ in.
Wing area: 338 sq. in.
Weight: 30 oz. as built
Wing loading: 12.76 oz./sq. ft.
Length: 22 in.
Engine used: O.S. .10
Number of channels: 3 (throttle, elevator, ailerons)
Prop used: 8x8 APC*
Radio used: Futaba* FP-T4NL
Construction: all balsa with spruce wing spars
Airfoil type: symmetrical



Features: essentially, the Wonder is a flying wing with a fuselage and large tail feathers. The fuselage allows ample room in which to mount your radio gear, and it provides a nice "grab area" for hand-launching. The symmetrical wing makes the Wonder a very forgiving aircraft, but the lack of a rudder limits the plane's aerobatic capabilities.

Hits
- Easy to build
- Easy and fun to fly
- Low price
- Lots of hardware

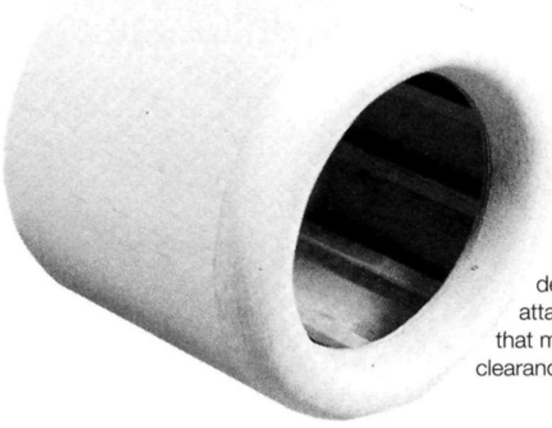
Misses
- Folded plans

HOW TO

Lightweight, coverable and inexpensive

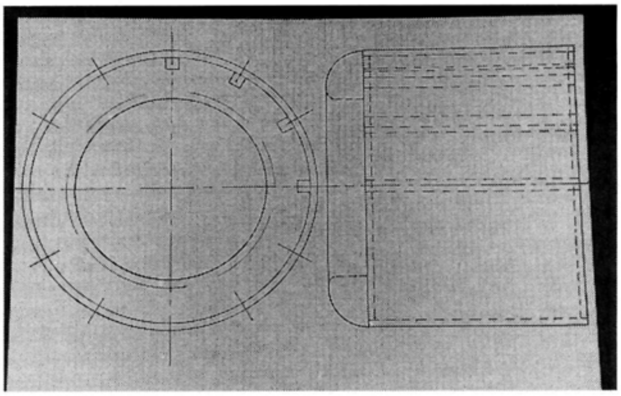
Build a Radial Cowl

by FAYE STILLEY

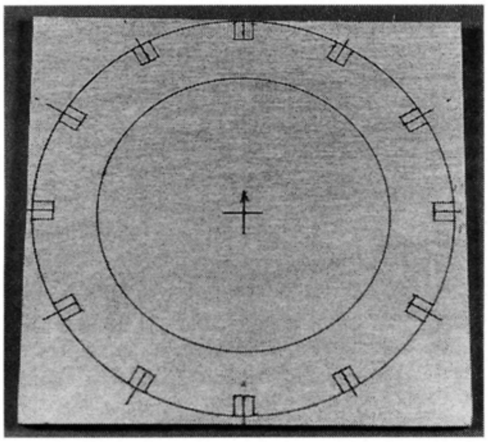


1 After measuring the firewall, the engine and the muffler, a plan should be drawn to scale. The measurements are important as they establish the cowl's diameter and length. They also help to determine the location of the attaching screws and the area that must be cut away for engine clearance.

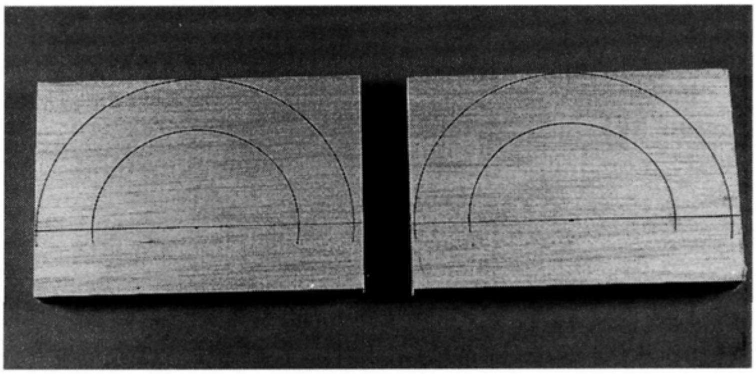
To me, a radial cowl is a thing of beauty, and it can really enhance the appearance of an aircraft. Building a radial cowl from scratch is much simpler than the finished product might suggest.



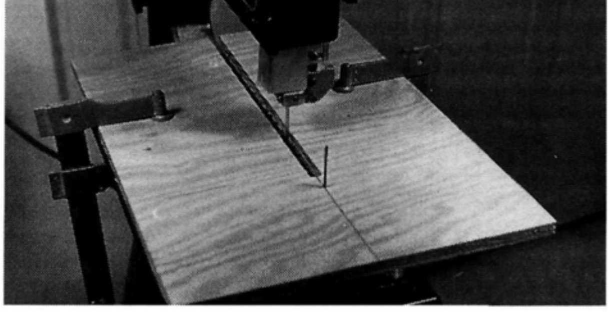
2 You don't need a complete mechanical drawing, but you should have all the critical dimensions. Make a full-size drawing so you can check the measurements as you build. This also prevents clearance errors because both the inside and outside dimensions are drawn. For a perfectly round radial cowl, the engine thrust line is in the center of the forward opening. The center lines on the plan, therefore, indicate the thrust line. The stringers are placed 30 degrees apart, which is an arbitrary decision based on the circumference of the cowl. Only enough stringers are required to provide necessary strength and to ensure that the sheeting will conform to the curvature.



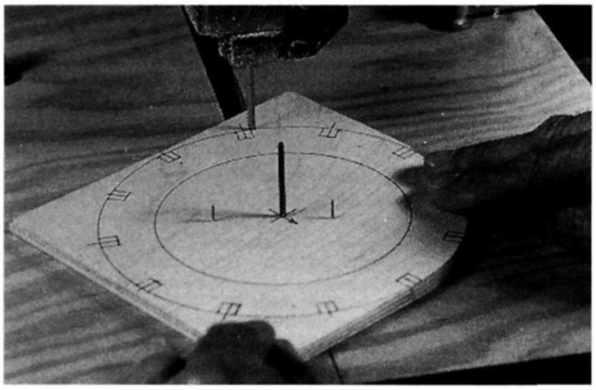
3 Transfer the drawing for the front and back support rings to the plywood. The complete drawing should be made at this time because, later, a hole will be drilled in the center. Once the hole has been drilled, a compass can no longer be used to draw circles.



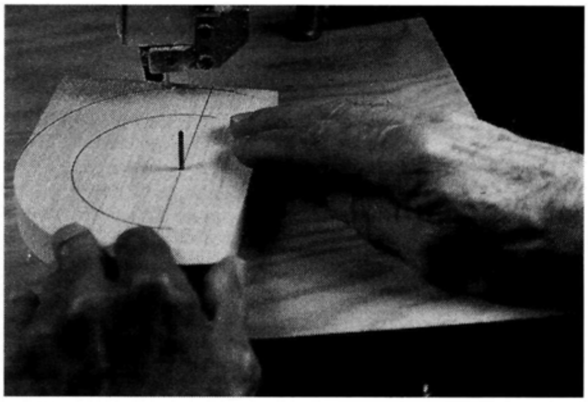
4 The cowl's nose ring is made of balsa. Once again, the plan is drawn on the wood. Use 3- and 4-inch-wide balsa stock to make the nose ring (extra-wide balsa stock is very expensive). This cowl was small enough so that the nose ring could be made of two pieces of wood. Large cowls may require three, four, or even more sections. It isn't obvious from the photo, but the balsa nose ring is 1/4 inch larger in diameter than the ply support rings. This is to compensate for the 1/8-inch-thick sheeting. We're just about ready to begin making sawdust.



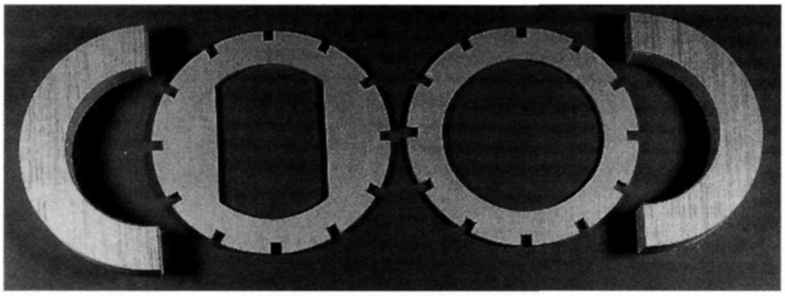
5 This is a simple jig for cutting circles. Made of plywood with a slot cut down the middle, a jig can be used on a scroll saw or a band saw to cut circles of almost any size. The slot is made wide enough to allow for your widest saw blade, plus a little room for clearance. The post is a common nail that's lined up with the cutting edge of your saw blade. Drilling an undersized hole in the wood allows you to hammer the nail in place without bending it. The nail must be straight in order to cut perfect circles. Once the nail is in place, round off the point with a file.



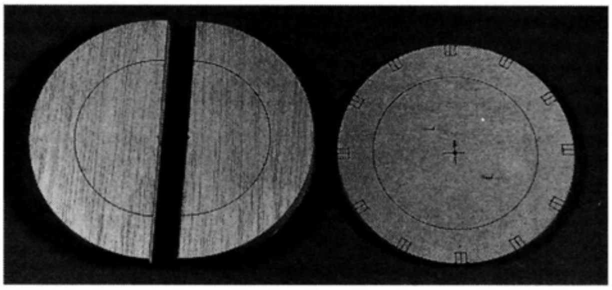
6 The plywood stock for the front and rear supports has been nailed together using two small nails. The nails hold them together so that they'll be identical after the cutting has been completed. Once nailed together, a hole is drilled in the center. The nail in the jig should fit snugly in the hole. Before placing your work on the jig, put soap on the post nail. This makes it easier to slip the wood onto the nail, and it provides lubrication while cutting. The picture shows the cut partially completed. Note that the jig is just clamped to the table of the saw. It will be clamped in position once the exact distance between the saw blade and the post nail has been set.



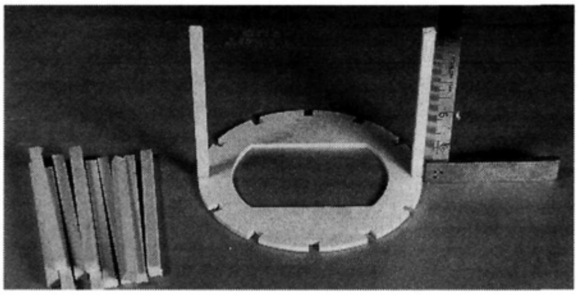
7 The jig is reset for the larger diameter of the balsa nose ring. The cut is made using the same method used to cut the plywood. Slowly turning the piece gives the smoothest cut. Note that the drawing on the balsa has the flat side. This allows space for the center hole, which has to be dead center for a perfect circle.



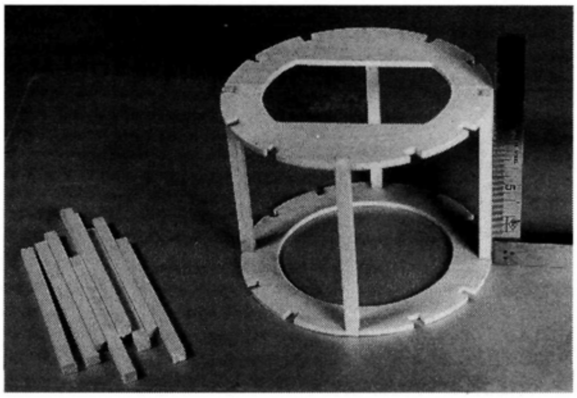
8 Before the inner cuts are made, notches for the stringers must be cut. With the two plywood pieces still nailed together, cut the notches. This will ensure that they line up perfectly when the cowl is built. After the notches are cut, the plywood pieces are separated.



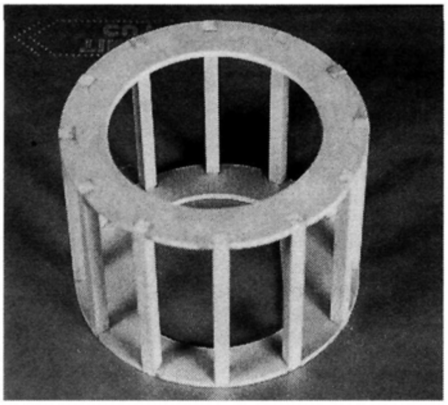
9 The inner holes in the front and back supports will, in most cases, be different. The front support is cut to fit the nose ring, while the rear support must provide clearance for the engine, the fuel line, the pressure line, the throttle pushrod, etc. The rear support must also provide space for mounting screws. A scroll saw works well for this type of work.



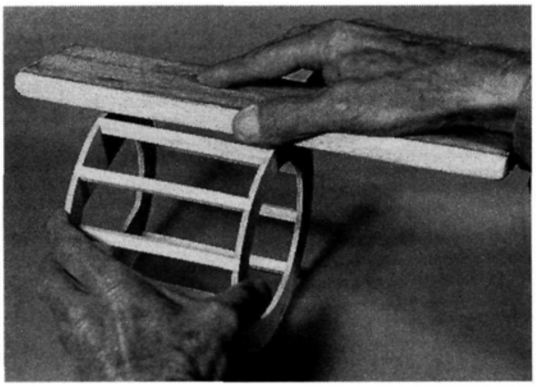
10 Cutting all the stringers to the exact length will make the next step simpler and quicker. Place the rear support ring on a very flat surface (a piece of glass works well). The next few steps are critical for a perfectly square substructure for the cowl sheeting. After covering the flat surface with wax paper, place a stringer in one of the notches. Make sure that it's perfectly perpendicular to the flat surface by using a good square. While holding it in position, use a drop of thin CA to temporarily "nail" it in place until the joints can be reinforced with thick CA. Add a second stringer opposite the first.



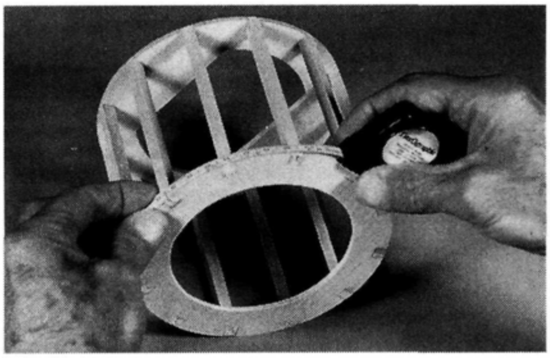
11 Put the front support ring on the flat surface, and push the stringers into place. If you have cut all the stringers to the exact same length, you can push them against the flat surface and feel reasonably assured that the other ends will be even. Using the square again, CA the stringers to the front ring.



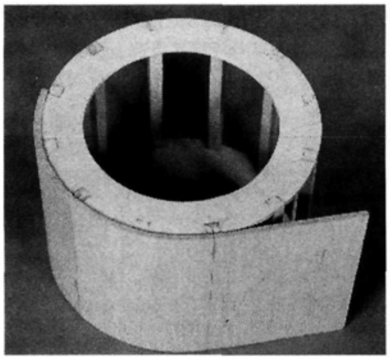
12 Add the rest of the stringers, checking for squareness as you go. After everything is in place, reinforce the stringer joints with thicker CA.



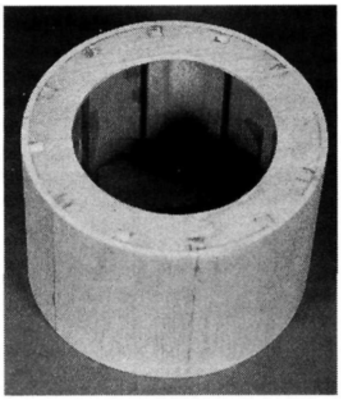
13 The stringers should be sanded with a large sanding block to ensure that they conform to the roundness of the support rings. The large, flat, sanding block helps make the curvature of the stringers uniform from front to back. If you didn't cut all the stringers to exactly the same length, sanding will be necessary on the front and back supports to ensure that they're flat.



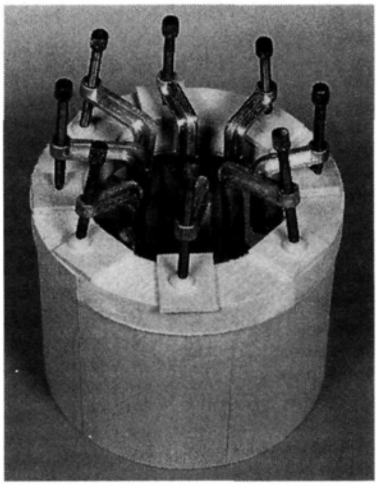
14 It's time to cut the sheeting for the outside of the cowl. If you don't want to mess with the math in order to determine the centers of the stringers around the circumference of the cowl, simply measure them with a small tape measure. Cut the sheeting to size, but leave one piece oversize. The oversize piece will be used last, and it will be cut to compensate for any discrepancy caused while the sheeting is being glued into place.



15 Care must be taken when gluing the butt joint between the sheeting. Any excess glue on the outside of the sheeting will cause sanding and finishing problems. All glue should be applied from the inside of the cowl. When the sheeting is glued together, the edges should be glued squarely against each other before they are bent around the curved shape. This reduces the gaps and the amount of adhesive that can penetrate the outer surface.

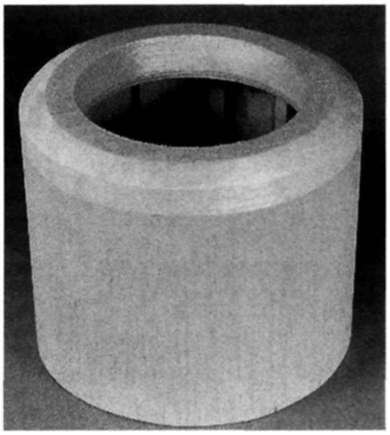


16 Once the sheeting is in place, the front and rear support rings should be inspected and sanded if they aren't perfectly flat. When you're satisfied that the surfaces are flat, the balsa nose ring can be glued in place.

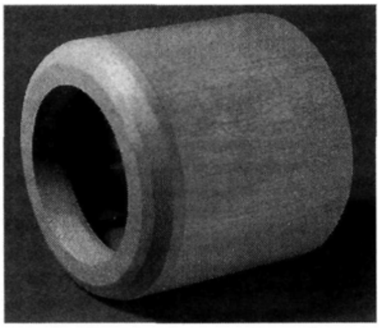


17 Fit the balsa nose ring, and glue it into place using aliphatic wood glue. The wood glue allows time to position and clamp the pieces in place. Clamp the pieces tightly to minimize the seam that results from the joint. This is important because this seam runs around the front of the cowl. It should be very thin, otherwise, it will be difficult to sand and finish. Attach the two-piece nose ring to the cowl so that the seams are on the sides where they'll be less visible. This is a good time to fill any gaps in the sheeting seams with balsa filler.

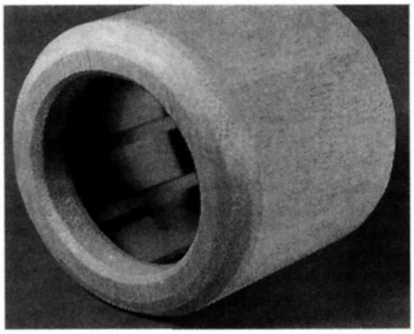
18 Begin to shape the nose ring by making all the surfaces square with each other. The outer surface should be sanded so that the balsa ring and the sheeting blend together and form a cylinder. The front of the balsa nose ring must be sanded flat so that it's square with the outer surface. Finally, the inner surface of the opening must be sanded square with the front surface. A round sanding tool, or a large dowel wrapped with sandpaper, is used for sanding the inner surface.



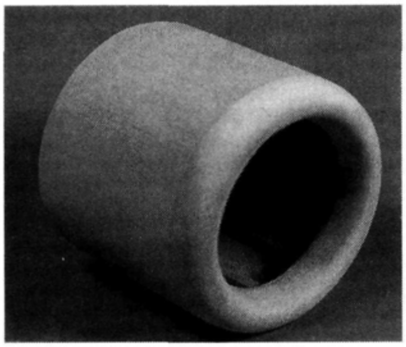
19 We're now faced with a task that's similar to shaping the airfoil on the wing's leading edge. The cowl's leading edge is shaped like the profile of a wing airfoil, except that it's in a circle rather than along a nice straight edge. Begin by beveling the outer edge of the nose ring. The bevel should be flat and have the same width all the way around the cowl. By making the bevel flat, you can observe the width as you progress. Keeping the width uniform allows you to see the bevel's relationship to the square surfaces. When the bevel is finished, the adjacent square surfaces should also be a uniform width all the way around the cowl. This ensures that the final curvature will be the same. The picture shows the first bevel completed. Note that the flat front of the cowl is a ring of uniform width. The remaining balsa stock around the outer edge is also the same width all the way around the cowl.



20 The shaping continues by sanding a second bevel around the forward edge of the first. Note that there are now four "rings" around the cowl, and that the basic curvature is taking shape.



21 Continue to shape. A bevel is sanded around the inside of the cowl opening. Use a round sanding tool when you work on the opening. The shape around the opening is similar to that on the bottom of the wing's leading edge. The shape is achieved by continuing to make bevels, each progressively narrower, until the sharp edges of the bevels almost disappear.



22 The edges of the bevels are removed in the final sanding process. Use fine-grit sandpaper (no. 400) wrapped around a small flat tool, e.g., a tongue depressor or a Popsicle stick. A small dowel wrapped in sandpaper is used for the surfaces near the opening. When everything looks perfectly smooth, use a small piece of no. 600-grit sandpaper to "polish" the whole surface.

Follow these simple techniques to design and build your own scratch-built, custom cowl. It's easier than you might think. ■

'94 AVIATION EXPO

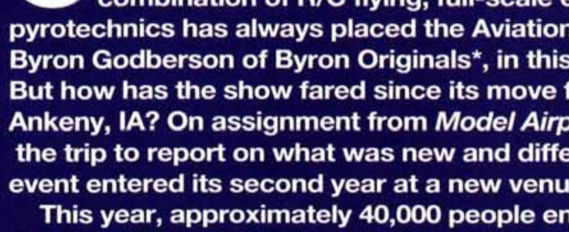
As at Ida Grove, the Ankeny site features a massive, 600x40-foot runway.

Full-scale and R/C spectacular

Right: note enthusias giant-scale Ralph watches a crew repai AT-6's landing Note the designed station adjo the run

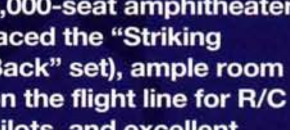
CERTAIN R/C EVENTS stand out above others because of the sheer magnitude of the spectacle. The unusual combination of R/C flying, full-scale exhibition flights and pyrotechnics has always placed the Aviation Expo, founded by Byron Godberson of Byron Originals*, in this special category. But how has the show fared since its move from Ida Grove to Ankeny, IA? On assignment from *Model Airplane News*, I made the trip to report on what was new and different as this huge event entered its second year at a new venue.

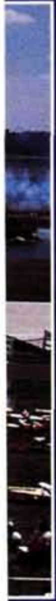
This year, approximately 40,000 people enjoyed the show, and the weather was almost perfect for all five days. Joe Schumacher, president of Aviation Expo, and his supporting cast did an outstanding job. There were plenty of bleachers for spectators (a 6,000-seat amphitheater faced the "Striking Back" set), ample room on the flight line for R/C pilots, and excellent facilities, whether you were camping or just making a day trip.

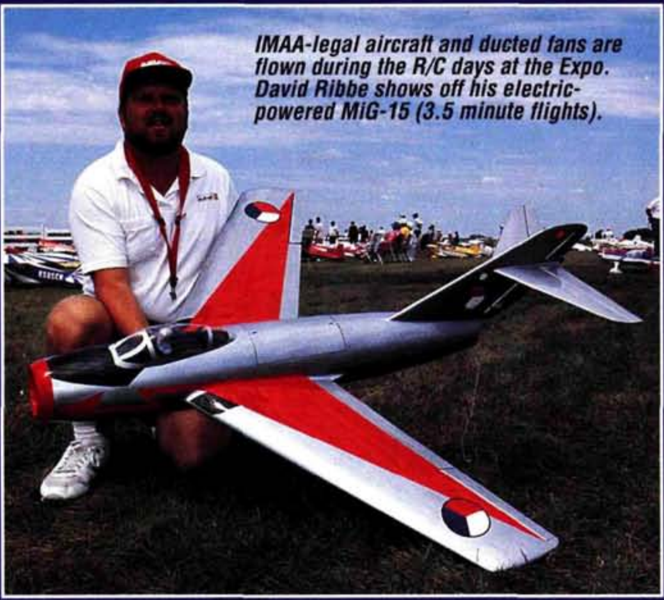


Jim Franklin's Waco Mystery Ship dazzled the crowds.

b y R i c h G r a h a m

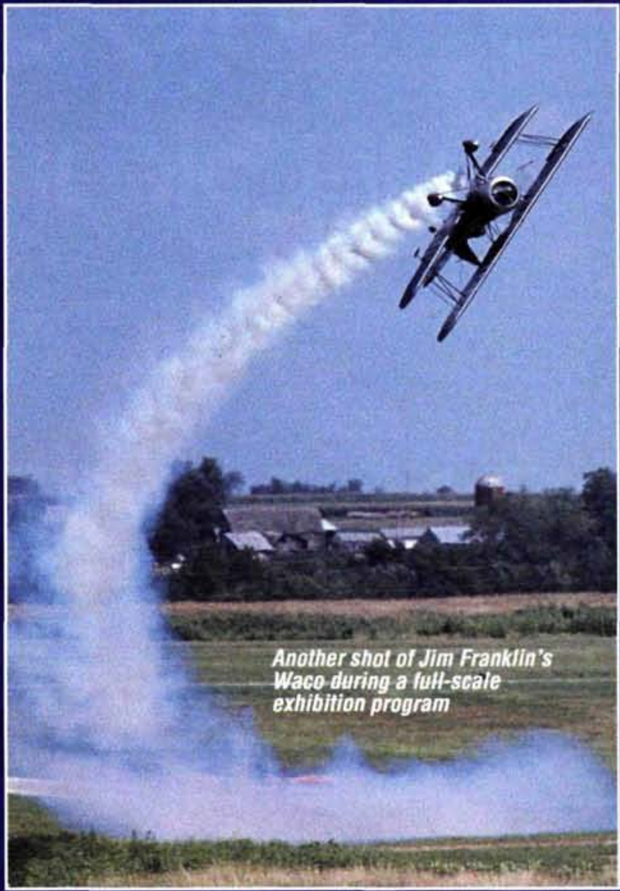






IMAA-legal aircraft and ducted fans are flown during the R/C days at the Expo. David Ribbe shows off his electric-powered MiG-15 (3.5 minute flights).

The Cloud Dancers' Byron Originals F-15s in tight formation during an exhibition flight.



Another shot of Jim Franklin's Waco during a full-scale exhibition program

The Striking Back show features riveting pyrotechnics.

Randy Geern of Taylor, MO, flew his beautiful Byron Originals Staggerwing at the Expo. Joe Schumacher, Expo president, is considering adding one or two more days of R/C flying to the event.

PYROTECHNIC SPECTACLE

One of the most impressive features of the show was the WW II set, behind the runway, that was used during the "Striking Back" enactment. Every day, a re-creation of the war over the Pacific was staged—complete with dogfights, carrier takeoffs, miniature tanks and miniature PT boats. As in past years, the sounds of bomb blasts, machine guns and general mayhem and the accompanying fireballs and explosions were impressive.

Besides the numerous R/C P-51s, Corsairs and Zeros that did battle during the simulation, there were flybys of B-25s, P-38s and what may be the world's largest flying model—the 1/5-scale replica of the Enola Gay B-29 bomber. The B-29 has a 29-foot wingspan, and it's powered by four Quadra-100 engines that spin Zinger 26x8-14 propellers at approximately 5,800rpm. "Striking Back" ended with a tremendous fireball and mushroom cloud that represented the dropping of the atomic bomb.

The Aviation Expo provides riveting entertainment and an opportunity to fly R/C aircraft with fellow modelers.

MODEL FLYING

Each day of the Expo, time was allotted for R/C pilots to perform and show what their models could do. More than 300 pilots attended the show, and nearly 500 model aircraft took to the air. IMAA-legal aircraft (80-inch wingspan for monoplanes, 60-inch wingspan for biplanes or true 1/4 scale) could fly on the 600x40-foot runway; and 10 pilot stations were available. "Next year, we plan to expand the time allotted each day for the modelers," says Joe Schumacher. His goal is to increase pilot participation in the Expo. Word has it that this may include one or two days that are devoted to R/C flying.

AT-6 PYLON RACING

The AT-6 pylon races were among the favorite events. Twenty-four pilots competed twice a day for the chance to reach the championship. A total purse of $1,900 was given to the top four finishers—Dennis D. Crooks from Illinois (first), Bubba Spivey from Georgia (second), J. Michael Bruno from Texas (third) and Rich Dufern (fourth)—with $1,000 going to first place. It was a thrill to see those big planes and their pilots being pushed to the edge.

EXHIBITION FLIGHTS

The Expo offered one of the best full-scale aerobatics programs I have seen; some of the most exciting performers on the air-show circuit wowed the crowds. These performers included Sean D. Tucker, Jim Franklin and the Waco mystery ship, the Sierra Aces and Wayne Handley with his agrobatics demonstration. Agrobatics is a form of aerobatics that incorporates crop-dusting techniques with traditional aerobatic maneuvers. Wayne had a lot of people on the edge of their seats with his heart-stopping, low-altitude stunts.

The Cloud Dancers showed their R/C flying techniques. Piloting Byron Originals F-15s, they performed some of the most amazing, tight, formation flying seen anywhere. Also, the Lanier R/C* team demonstrated a breathtaking aerial ballet.

EXHIBITORS

More than 60 exhibitors sold their products to enthusiasts. There were also plenty of places to shop for almost anything you could think of pertaining to aviation.

Joe Schumacher has dedicated his time and energy "...not to let up until the event is perfect"; and his efforts are yielding fruit. The Aviation Expo provides riveting entertainment and an opportunity to fly R/C aircraft with fellow modelers; and it presents the sport of R/C to thousands of spectators in a safe and responsible fashion. Looking at the big picture, it's not only a great show, but it's also good for the hobby. In '95, the Expo will be held from July 19 to July 23. If you have the time, check it out. For more information about Expo '95, or to order the video of Expo '94, write to: Aviation Expo, P.O. Box 498, Ankeny, IA 50021.

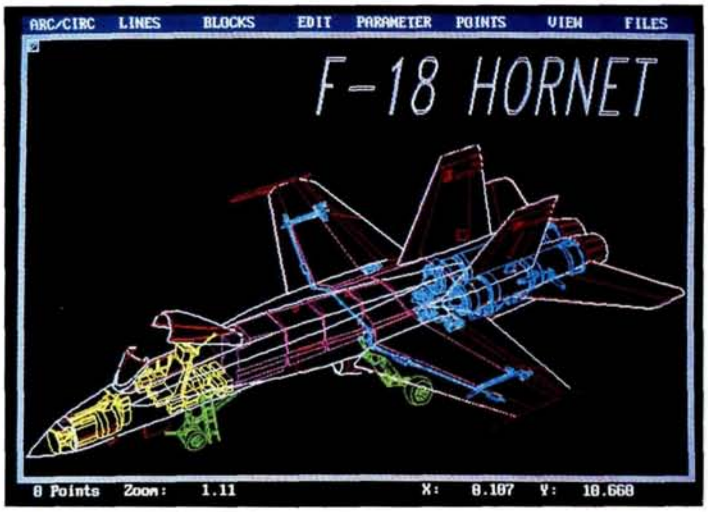
Addresses are listed alphabetically in the Index of Manufactures on page 177. ■

The Model Airplane News

Survey of Programs for Modelers

Emerging software supports model design, construction and analysis

by DAVE GARWOOD

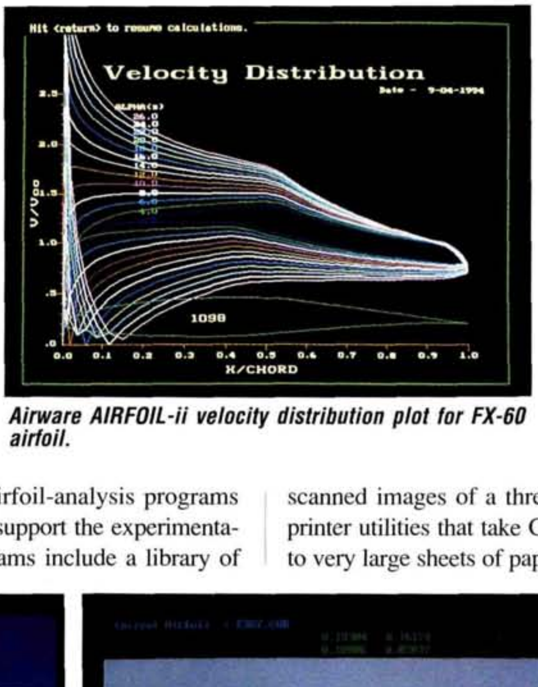


ModelCAD includes a tremendous number of CAD capabilities.

While about a quarter of U.S. homes have a computer, over half of *Model Airplane News* readers use them, according to reader surveys. Computers work for us as writing machines, personal organizers, game platforms and launch pads for electronic communications. Many aeromodelers use their computers to support hobby activities, and probably many more would if they knew the range of modeling programs available.

To help in this area, *Model Airplane News* commissioned a survey of the aeromodeling software programs currently available. We sent surveys to 31 software publishers to learn about their programs to support model airplane design, construction, and analysis. Information from those who responded is presented in the table that makes up most of this article. This is the largest modeling software listing published to date, as far as we know.

Because of the complexity of the R/C flight simulators, such as Radio-Control Flight Simulator*, Skylark* and AeroChopper*, I will discuss them in a future article.



Airware AIRFOIL-ii velocity distribution plot for FX-60 airfoil.

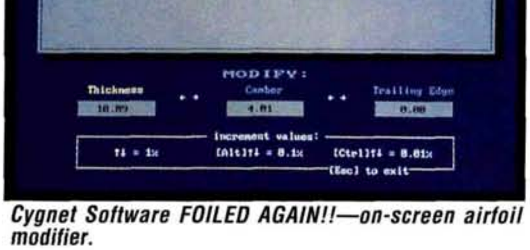
MODELING PROGRAMS

Airfoil design, analysis and plotting software make up the largest group of the survey. These programs take airfoil layout off graph paper and put it onto the computer screen, making it easier and quicker to scale accurate airfoil sections and to cut balsa ribs or foam-cutting templates. The airfoil-analysis programs model the behavior of air over the wing and support the experimentation and design of new airfoils. Many programs include a library of pre-loaded airfoils and allow entry of airfoil coordinates from outside sources.

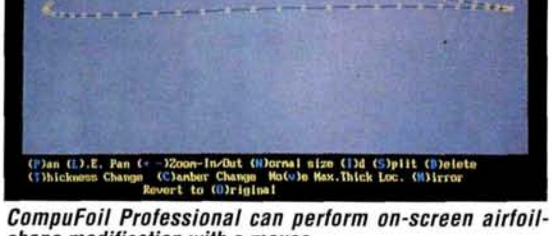
Computer Aided Design, or CAD, programs are the next biggest group— again moving work from graph paper to the console and maybe saving some time in the balsa dungeon. Accuracy and productivity are up, frustration and time wasting are down. The number and variety of analytical tools available in these programs is amazing, while their cost is affordable.

Also in the CAD category are utility programs that assist in converting scanned images of a three-view drawing into a CAD file. We have printer utilities that take CAD output designed for pen plotters writing to very large sheets of paper and redirect the output to tractor-feed dot-matrix printers. These types of program increase the flexibility and capability of the CAD programs.

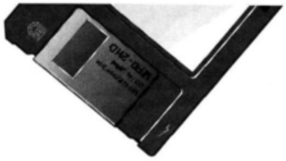
The third most populous category contains the performance analysis and prediction software. These programs provide analytical support to modelers seeking to enhance aircraft performance. Two emphasize electric-powered airplanes; others concentrate on sailplane performance.

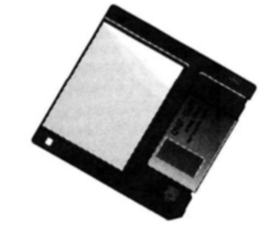


Cygnet Software FOILED AGAIN!!—on-screen airfoil modifier.



CompuFoil Professional can perform on-screen airfoil-shape modification with a mouse.





Model Airplane News survey of computer programs for modelers

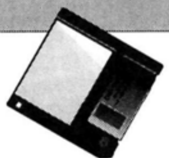
Compiled by Dave Garwood in September 1994 from information supplied by software publishers

Table 1

Program Name	**AIRFOIL-ii**	**The Eppler Airfoil Design and Analysis Code** 7/5/94 ver	**Hans-Walter Bender Airfoil Encyclopedia**	**Soartech 8 Airfoils Data Disk**
Program Type	Airfoil design and analysis	Airfoil design and analysis, including sailplane performance	Airfoil design and analysis	Airfoil design and analysis
Computer required	IBM PC, XT, AT or compatible with CGA, EGA, VGA, Hercules or compatible graphics adapter	IBM 8086 or higher	IBM 80386 or higher running Windows 3.1	Not applicable (printer driven by program this data is imported into)
Printers supported	Many dot-matrix printers and HP LaserJet	HP LaserJet and PostScript compatible laser printers	Any Windows-supported printer	IBM 8086 or higher
Major program features	A collection of low speed airfoil analysis design tools, including: (1) Velocity distribution along the surfaces of the airfoil, (2) Boundary layer development diagram which gives a quick visual check on laminar–turbulent transition, and (3) Lift–drag polar gives a summary of airfoil performance. The analyses can be viewed on screen or printed.	Conformal–mapping method for design of airfoils with prescribed velocity distribution characteristics. Panel method for analysis of the potential flow about given airfoils. Boundary layer method, so airfoils with prescribed boundary layer characteristics can be designed and airfoils with prescribed shapes can be analyzed.	This incredible airfoil coordinate data bank contains 2435 sets of airfoil coordinates. If data has been published on an airfoil, it's in this program. Also available is a powerful Windows program by Ludwig Wiechers which displays, combines, blends and prints airfoils.	This is the data from the Princeton low speed wind tunnel tests. This collection includes all tables, all coordinates, and all polars on the airfoils presented in SoarTech 8. It's designed to be used to import the data into any airfoil design program.
Special features	The Eppler analysis used in AIRFOIL–ii has been demonstrated by comparison with wind tunnel data to provide accurate analysis for many, if not most, airfoils.	Multi-point design capability	The Windows program calculates and displays velocity distributions around airfoils.	This is the complete collection of data printed in *Airfoils at Low Speeds.*
Technical support	Not specified	None	Letters and phone calls (804) 428–8064	Letters and phone calls (804) 428–8064
Price	Full program—$395 *Demo disk—$10*	$1,500 *Write for free brochure*	Bender collection—$145 *Windows program to run—$120*	$12—U.S. *$14—elsewhere*
Order from	AIRWARE; PO Box 295, Canton, CT 06019; (203) 693–8635.	Somers and Maughmer, Inc. (sole North American distributor); PO Box 796, State College, PA 16804–0796.	SoarTech Journal c/o H. A. (Herk) Stokely 1504 N. Horseshoe Cir., Virginia Beach, VA 23415; (804) 428–8064.	SoarTech Journal c/o H.A. (Herk) Stokely 1504 N. Horseshoe Cir., Virginia Beach, VA 23415; (804) 428–8064.

Table 2

Program Name	**Airfoil Plot** ver 6.0	**CompuFoil Professional** ver 1.92	**Foil 1.2**	**FOILED AGAIN!!!** Ver 2.09
Program Type	Airfoil plotter: print patterns and templates	Airfoil plotter: generate rib and foam templates	Airfoil plotter: create, display, print airfoils	Airfoil plotter: convert from numerical data
Computer required	IBM XT compatible with DOS 3.2	IBM 80286 with VGA graphics (EGA available on special request)	Any Macintosh with System 6 or greater	IBM PC AT with VGA graphics
Printers supported	9- and 24-pin dot matrix, and HP LaserJet II and later laser printers	HP LaserJet, HP Deskjet, Bubblejets, 9 and 24-pin dot matrix, pen plotter	Any quickdraw printer	Dot matrix and laser
Major program features	Plots airfoils and Feather/Cut foam core templates, up to 40 inch chord. It allows user to change camber, thickness, and combine airfoils. You can display airfoils on screen if CGA, EGA, or VGA monitor is available. Includes 42 airfoils and data entry module for entering others. The Pro version has 150 airfoils and includes AFEdit, an airfoil editing and viewing program that can display up to three airfoils. AFEdit requires EGA or VGA graphics.	Integrated environment for airfoil preview, modify, and print. Built in easy to use CAD allows for direct airfoil manipulation, change camber, thickness. Computes transitional airfoils. Templates for foam cutting or full sets of ribs. Templates may include spar slots and turbulator ribs, building jig holes, washout, leading edge, leading edge v-notch. Computes full set of elliptical planform ribs. Exports standard. DFX file for CAD programs and CNC machines.	Creates, displays and prints NACA 4/5 airfoils, large library of airfoils, including NACA 6–, 7–, and 8– series. Different viewing options, scanning feature to derive coordinates from scanned airfoils. Reads and writes airfoils to text files or Mac pict. files.	Plots airfoils from numerical data, a job that is tedious and time consuming to do by hand. Easily and quickly plots multiple airfoils, and automatically calculates rib sizes needed for tapered and elliptical wing shapes. Program comes with 52 airfoils which the user can easily vary in thickness, chord and camber. Supplied with well-written and well-organized 25- page user manual.
Special features	Available since 1984, the program is easy to use and runs on any MS/DOS computer and does not require EGA or VGA graphics.	Feather/Cut calculator. Leading edge hot wire kerf compensation, integrated Many preview options. Integrated CAD utility, math calculator and text editor.	The program is free. Runs on a Macintosh.	Browse airfoil shapes on screen. Program operation is nearly intuitive, and easy for those with some PC and airfoil experience may be able to skip the manual.
Technical support	Letters, phone: (615) 455–5788 CompuServe: 73757,1144 *E-mail: canders@edge.ercnet.com*	Phone calls during evening hours (513) 299-7684	Phone (408) 738–6688 Fax: (408) 738–6871 *E–mail: greg@aerometrics.com*	Phone calls during evening hours (619) 792–8021
Price	Standard version—$35 Professional version—$60	With standard airfoils—$65 190 airfoil library—$12	Free from Internet FTP sites (Mac archives) or send a formatted disk with stamped return disk mailer	$59.95
Order from	Northeast Sailplanes or Chuck Anderson PO Box 305 Tullahoma, TN 37388 615 455–5788	Eric Sanders 3904 Traine Drive Kettering, OH 45429; day: (513) 455-6305 eve: (513) 299-7684	Gregory Payne Aerometrics, Inc., 550 Del Ray Ave., Sunnyvale, CA 94086; FTP wustl.wuarchive.edu	Bernie Crowe CYGNET Software, 3525 Del Mar Heights Rd. #237, San Diego, CA 92130; (619) 792–8021.



THE MODEL AIRPLANE NEWS SURVEY OF PROGRAMS FOR MODELERS

Table 3

Program Name	NACA Generator ver 1.3	CaddView ver 2.0	Computer Aircraft Designer ver 2.1	ModelCAD
Program Type	Airfoil plotter: generate airfoil coordinates	Computer Aided Design: trace and import vector drawings of plans, drawings, topographic maps	Computer Aided Design: 3 dimensional CAD and aerodynamics analyzer	Computer Aided Design: CAD with design calculator and ModelCalc included
Computer required	IBM 286 with VGA graphics, (EGA version available on special request)	IBM 80286 and VGA video and mouse to trace images	IBM 80286 with EGA, VGA, or SVGA graphics, mouse	IBM 8086 or higher (Windows version coming)
Printers supported	HP LaserJet, HP Deskjet, Bubblejet, 9 & 24-pin dot matrix, pen plotter	Epson compatible dot matrix HP LaserJet II compatible laser	Dot matrix, HP LaserJet, or HP plotter	Lasers, dot matrix, and others; about 180 printers supported
Major program features	Point and click interface. Produces eight of the six digit NACA laminar flow airfoils (63, 64, 65, 66, 67, 63A, 64A, 65A series) in your choice of thickness and lift coefficient, five digit airfoils (210, 220, 230, 240, 250, 221, 231, 241, 251) in your choice of thickness, and four digit airfoil of cambers from 0–8%, camber positions from 10–90% in your choice of thickness.	A vector and raster program combined, it gives the ability to trace aircraft photos, diagrams, blueprints, illustrations, line drawings and output vectors in DXF (Drawing Exchange Format) and Generic CADD format for input into CAD programs.	Very flexible and easy to use. Full airframe design, including airfoils, formers. Displays 3D and perspective and on-screen rotation. Handles simple and oddball designs. Electronic wind tunnel–analyzes stability and control. Imports DFX, PCX, GIF files.	Operated with quick, single keyboard commands. Very flexible text handling in 16 fonts. Infinite zoom. Entity (object) selection for edit, copy, move, etc.. Includes airfoil symbols, many draw and edit tools. 63 layers, 16 colors. Unlimited scaling – draw model and print at infinite scales. Find center of gravity. Upgrades to DesignCAD. Free phone technical support.
Special features	The only commercially available, stand-alone program which can produce the NACA six digit airfoils. Built-in preview mode.	This stand-alone program requires no other CAD to run "under." Low cost. Nearest competitor costs about $10 and requires AutoCAD.	3D CAD and aerodynamics are completely integrated into a full spectrum design program, from wing rib placement to stall speed calculation.	Designed for modelers by modelers.
Technical support	Phone calls during evening hours (513) 299-7684	Phone (607) 264–8149 CompuServe: 71054,47	Phone: (703) 476–2438 e-mail: cad@access.digex.com BBS: 703 476–9832	Phone: (918) 825–4844, FAX: (918) 825–6359 BBS: 918 825–4878
Price	$18	$59.95 (free demo version by mail or download from CompuServe)	$79.95	$99
Order from	Eric Sanders, 3904 Traine Dr., Kettering, OH 45429; day: (513) 455-6305, eve: (513) 299-7684.	Monumental Computer Applications, 9 Genesee St., Cherry Valley, NY 13320; (607) 264–8149, FAX: (607) 264–3307 BBS: (607) 264–3307.	Computer Aircraft Designs, PO Box 96, Herndon, VA 22070; (703) 476–2438.	American Small Business Computers, One American Way Pryor, OK 74361–8801; (918) 825–4844.

Table 4

Program Name	Model Design ver 4.0	WingDesigner PRO ver 1.05 with EditFoil ver 1.0	Wingmaster Model Wing Designer	Member Master
Program Type	Computer Aided Design: airfoil, wing and utility plotter	Computer Aided Design: CAD/CAM mechanical design programs	Computer Aided Design: model wing ribs and planforms	Club management: club roster and dues payment
Computer required	IBM XT compatible with DOS 3.2	IBM 80286 with VGA graphics	IBM 80386 running Windows 3.1 or later in enhanced mode	IBM 8088 or higher, color only, hard disk recommended
Printers supported	9- and 24-pin dot matrix, and HP LaserJet II and later laser printers	Most 9- and 24-pin dot matrix printers as well as laser printers	Windows printers	All
Major program features	This program includes all of Chuck Anderson's Airfoil Plot 6.0 plus: It plots wing plans with up to five panels per half span. Rib sets can transition from one foil to another for each panel. Rib sets with washout. Plots angle templates. Plots circles, ellipses, and center of ellipses with flat inserts in top and bottom or sides.	Design constant chord or tapered wings with the same or different airfoils for the root and tip. Spars may be any size and don't have to be full length. Sheeting may be shown. Wing top view as well as ribs may be plotted. The PRO version exports in DXF format for import to AutoCAD. Spar cutouls are shown on each rib. All outputs available on screen so the design can be viewed before plotting. A design report may be printed. Expand command allows easy smoothing of the leading edge.	Select from more than 250 airfoils in library, including historical airfoils (Clark, Curtiss, USA, Gottinger, RAF) and more that 100 Eppler and modern airfoils. Customize any airfoil, modifying thickness and camber. Apply airfoils to wing design, using multiple airfoils in a wing. Print complete wing plans, to scale or fit–to–page. Produce plot files or transfer drawings to DesignCAD, ModelCAD, or other CAD software using HPGL output.	Allows entry of club member information including your choice of affiliations. Supports tracking of dues payment for various membership types. Prints full and abbreviated club rosters. Prints mailing labels.
Special features	Available since 1986, the program is easy to use and does not require EGA or VGA graphics.	Spars of any size or shape may be placed in any position on the wing. Show aileron and flap outlines. Place wing fixture hole targets on each rib. Sweep back or forward.	Produce NACA 4–digit, 5–digit, and 6–series airfoils. Look up answers quickly with extensive online help. Print large drawings on normal size printers using automatic paneling.	Provides dues payment history and shows each member's dues payments to date.
Technical support	Letters, phone: (615) 455–6430 CompuServe: 73757,1144 E–mail: canders@edge.ercnet.com	Will take phone calls after 7:00 PM Central Time (708) 213–3571.	Phone day: (918) 825–4844 evening: (918) 825–1008	CompuServe 73157,3543
Price	Standard version—$50 Professional version—$75	Standard version—$129.95 Professional version—$169.95	$129	$32.95
Order from	Northeast Sailplanes or Chuck Anderson, PO Box 305, Tullahoma, TN 37388; (615) 455–5788.	C&J MicroSystems, Jim Darby, PO Box 8367, Bartlett, IL 60103–8367; (708) 213–3571.	Websoft Inc., 287 Cottonwood Rd., Pryor, OK 74361; Day: (918) 825–4844 Eve: (918) 825–1008, FAX: (918) 825–7205.	Chandero Systems, Inc., Robert A. Blaney, 14 Parkview Rd., Long Valley, NJ 07853; (908) 852–2674.

In addition to these categories, there are programs to help you find magazine articles, to analyze performance of battery packs, to optimize use of building materials, to manage radio frequencies at the flying field and to keep track of club member information. If you're ready to use your computer to support your hobby, there's no shortage of software available to help you do it.

PROGRAMS NOT YET AVAILABLE

The programs that seem under-represented to me are those that help with club management and operations, such as frequency-control systems and contest scoring. Is there a development opportunity here? Will modelers buy these programs if programmers develop them?

We have general database programs, and one specific magazine

Table 5

Program Name	Mag–Track	AREA10 ver 1.0	Scanover	Dot Matrix Plotter
Program Type	Magazine article locater	Design and other utilities: Wng area / wing loading calculator.	Design and other utilities: trace scanned images into CAD	Design and other utilities: print drawing to multiple pages
Computer required	IBM 8086 or higher, needs only a floppy drive and text screen	IBM 80286 or compatible	IBM AT with VGA 16 colors	IBM compatible
Printers supported	All	Dot-matrix and HP LaserJet	None needed	IBM and EPSON compatible dot matrix
Major program features	Locates articles in your personal library by indexing those you may want to refer to again. The data entered includes article title, author, publication, issue, and page. The user can search for an article online or print a list of indexed articles. This is a public domain program previously published in text form. For those who do not wish to type in the 120 lines of BASIC code, the program is available on diskette.	Quick and easy to use wing area and wing loading calculations for models of any size. Automatic calculation of mean average chord (MAC). Displays and prints a spreadsheet that plots wing loading for a range of gross weights. All data can be printed on both dot matrix and laser printers.	Provides a way to easily get a three–view or other drawing into your CAD program. Scanover is a TSR that allows you to trace scanned images on your CAD screen. Versions available for AutoCAD, DesignCAD 2–D, Envision It, Generic CADD, ModelCad. Please specify CAD program with order. Canadian and foreign orders: CAD–ART Systems, Ltd., 4801 45 Street St. Paul, AL, Canada TOA 3A3; (403) 645–3248.	Advanced plotter file printing system for IBM/Epson compatible dot matrix printers. Automatically prints large drawings to multiple pages. AutoCAD, Autosketch, CadKey, DesignCAD, Drafix Ultra, Envision It, Generic CADD, Micro Cadam, ModelCad and TurboCad HP–GL plotter files are supported. Canadian and foreign orders: CAD–ART Systems, Ltd., 4801 45 Street St. Paul, AL, Canada TOA 3A3; (403) 645–3248.
Special features	Diskette includes documentation, BASIC source code, and compiled version of MAG–TRACK program.	No other similar program available.	Windsoft Company will scan your drawings or three views for use with the program, for a very reasonable price. Call Bill Windsor for more info.	Paul Matt's scale airplane drawings available in Scanover TIFF format, licensed to Windsoft Company.
Technical support	Postal mail inquiries; Internet e–mail: 70254.361@compuserve.com	Phone and fax customer support voice/FAX 708 425–5885	Phone (302) 678–5174	Phone (302) 678–5174
Price	$9—specify disk size and density	$12.95 plus $5 shipping	$99.95—modeler's combination $144.95—with dot matrix plotter (basic)	$99.95—modeler's combination $144.95—with Scanover
Order from	Jim Harrigan, 103 Highland Ave., Rensselaer, NY 12144-1006.	Vortac Manufacturing Co., PO Box 469, Oak Lawn, IL 60453; voice/FAX (708) 425–5885.	Windsoft Co., 1405 Hopkins Ave., Dover, DE 19901–4003; (302) 678–5174; FAX (302) 678–4957.	Windsoft Co., 1405 Hopkins Ave., Dover, DE 19901–4003; (302) 678–5174; FAX (302) 678–4957.

Table 6

Program Name	Pattern Master	Design & Enlarging Tools for Modelers	RC Helper Ver 1.08	AERO*COMP Ver 2.1.E
Program Type	Design and other utilities: materials cutting optimizer	Design and other utilities: tool kit for enlarging designs	Design and other utilities: R/C tool kit	Performance analysis: for electrics (also glow, sailplanes)
Computer required	IBM 80386, Windows 3.1, VGA graphics	Any DOS-based PC	IBM 8088 (XT) 640k, CGA video	IBM 8086 or higher. Mouse, hard drive supported but not required.
Printers supported	All dot matrix and laser	Epson/IBM compatible dot matrix	Epson dot matrix, HP Deskjet, HP LaserJet and compatibles	All
Major program features	Reduces waste of balsa sheets and wing covering materials by generating cut patterns for flat sheet materials (any material sizes). Allows stock sheet inventory for many materials, and order entry for required pieces. Displays and prints graphical cutting diagrams. Online documentation and tutorial. Send SASE for descriptive brochure.	Four simple, traditional enlarging tools using your computer. No CAD program or CAD skills are required. The tools are: 1. Scaling Calculator; 2. Grid paper Maker; 3. Scale ruler printer; 4. Area calculator. RC Design Tools are easy to use and come with complete instructions. All you need to know is how to start the computer and use the keyboard.	1. BATTERY RATING: Uses a digital volt meter to rate battery packs. Calculates the discharge time for standard and other loads. Print results to page or pack labels. 2. GEAR RATIO: find final ratio, pinion/spur ratio, spur gear RPM. Print results to page or labels. 3. FREQUENCY PEG BOARD: Replaces messy clothespin boards with an easy to use, color coded frequency chart covering the 27, 50, 53 and 75MHz surface bands. Prints a 1 page frequency chart showing all channels.	Experiment to maximize your airplane's performance on a computer rather than on the workbench. The program analyzes the results of physical changes to the model with pull down menus and help screens. While designed for R/C electrics, also useful for gas/glow, ducted fans, helicopters, sailplanes and full-size aircraft.
Special features	Windows software, fully graphical. Unlimited quantity of pieces can be cut.	Concept Technology also offers a precision scanning service and a precision plotting service. Send SASE for price list and more info.	Easy to use, menu driven. Direct author support and contact. Trial version available from CompuServe (GO MODELNET, Library 7, filename RCH108.ZIP)	Extensive electric motor data, with ability for user to add motor data. Ability to change one parameter at a time. Accurate calculations at high RPM and high air speed.
Technical support	Phone (908) 852–2674 CompuServe: 73157,3543	Phone (619) 486–2464 (evenings, weekends)	Postal mail, CompuServe e–mail, FidoNet RC_MODELS and RCM echos, TeleNet Canada TNC_RC_MODELS echo	Not specified
Price	$249; demo version—$15.	$19.95 plus $1 shipping	$15 (money orders only)	$79 plus shipping
Order from	Chandero Systems, Inc., Robert A. Blaney, 14 Parkview Rd., Long Valley, NJ 07853; (908) 852–2674 CIS ID 73157,3543	Concept Technology, Dave Bessel, PO Box 669, Poway CA 92074–0669; (619) 486–2464 (evenings, weekends)	Kent Timm, Team Timm R/C Software, 1229 Marlborough Ct. Ste. 608, Oakville, ON, Canada, L6H 3B6; e–mail address: 74647.3552@compuserve.com	Hobby Lobby, Tower Hobbies, Kavau Co. or the publisher: USR&D Corp., PO Box 753, Hacketstown, NJ 07840–0753; (908) 850–4131.

article indexing program, but, apparently, no offering by the model magazines to distribute magazine index DATA on diskette. Maybe one or more of the model publishing houses will be willing to supply the data, and maybe an enterprising programmer will help develop the software. Then we computer mortals will be able to easily locate several reviews, via our computers, to help decide which kit to buy next.

WHERE WE ARE GOING

What does the future hold for computer users and software publishers? The market looks bright to me. Increasingly sophisticated and engaging programs will involve increasing numbers of modelers in computer support of their hobby. More modelers using computers will expand the market for software makers. More computerized modelers

THE MODEL AIRPLANE NEWS SURVEY OF PROGRAMS FOR MODELERS

Table 7

Program Name	**Max–Soar ver** 3.0	**PC–Soar**	**Sailplane Design Program** ver 4.0	**Sailplane Design Performance Analysis Program –** ver 3.4
Program Type	Performance analysis.	Performance analysis.	Performance analysis; sailplane performance addiction	Performance analysis:
Computer required	Macintosh with hard disk and HyperCard version 2.1	IBM PC 8088 or higher with CGA or higher graphics adapter	IBM PC XT running DOS, CGA, EGA, VGA graphics optional (printer optional)	IBM 8086 or higher
Printers supported		Graphics compatible printer	Most dot matrix printers supported	Almost any printer will work
Major program features	Online documentation. Five sailplanes and 10 airfoils included. Use data provided or enter your own. English/Metric ability. Reynolds numbers effects calculated. Plot sink rate versus flying speed. Plot lift/drag versus flying speed. Overlay plots for comparison. Calculate design parameters like area, aspect ratio, aerodynamic center, average chord, tail volume, instability factors, equivalent dihedral recommended, CG limits and more. MaxSection plotter included.	Online documentation. Five sailplanes and 10 airfoils included. Use data provided or enter your own. English/Metric ability. Reynolds numbers effects calculated. Plot sink rate versus flying speed. Plot lift/drag versus flying speed. Overlay plots for comparison. Calculate design parameters like area, aspect ratio, aerodynamic center, average chord, tail volume, instability factors, equivalent dihedral recommended, CG limits and more.	Generates L/D and sink rate vs. velocity curves for sailplanes. Princeton airfoil data can be used in analyses. Multiple performance curves can be generated to show the effect of adding ballast or moving the CG location. Wing geometry can be specified in up to five segments per half span.	David Frasier's model sailplane performance analysis program that allows the user to vary the airfoil, wingspan, wing area, and center of gravity to determine their effects on the flight characteristics under design. Frasier was the instrumentation engineer working with Michael Selig and John Donovan on the Princeton Low Speed Airfoil tests. He was killed in an aircraft accident in 1992.
Special features	Sailplane Design Library includes 51 popular sailplane types. Airfoil Section Library includes 228 wind tunnel and theoretical polars from MTB, SoarTech, and Althaus.	Also available from LJM associates: laser cut airfoil templates for precise wing construction or foam wing-core cutting.	Accurate wing drag data is calculated for each wing segment and combined to get an overall wing drag coefficient.	Included with this program is the Princeton wind tunnel test data and several pre–entered aircraft parameter files.
Technical support	Not specified	Not specified	Letters and phone calls (615) 690–3180	Will answer letters and take phone calls at (804) 428–8064
Price	MaxSoar—$70, includes MaxSection. Libraries—$15 each.	PC–Soar—$40 Airfoil libraries—$15 each	$25—U.S. $30—foreign	$35—U.S. $37—elsewhere
Order from	ImagiSoft, John Hohensee, S22 W27400 Fenway Dr., Waukesha, WI 53188; (414) 521–2472 after 5:30 PM weekdays.	LJM Associates, Lee Murray, 1300 N. Bay Ridge Rd., Appleton, WI 54915; (414) 731–4848 after 5:30 PM weekdays	The Soaring Edge, Edward J. Dumas, 3220 Boomerang Ln., Knoxville, TN 37931; (615) 690–3180.	Soartech Journal c/o H.A. (Herk) Stokely, 1504 N. Horseshoe Cir., Virginia Beach, VA 23415; (804) 428–8064.

Table 8

Program Name	**Electro Flight Design**	**Ducted-Fan Performance Prediction**	**Encyclopedia of Boeing Aircraft**	**Aero Design**
Program Type	Electric-model performance predictor	Performance predictor for fuel-powered ducted-fan models	Information package for documentation, etc.	Design and other utilities.
Computer required	IBM 80386 running Windows 3.1 (currently working on MS/DOS version)	IBM 80286 or higher, MS/DOS (Windows version coming)	PC running Windows 3.1; 20 megabytes of hard disk space required for installation.	IBM compatible, DOS 3.0 or greater
Printers supported	Any windows printer	No special printer required		Print through DOS
Major program features	Calculates model drag and required horsepower, electric motor performance, optimum propeller for any flight regime and performance over flight regime for selected propeller.	Input the fan physical characteristics, the atmospheric conditions, the motor power curve and inlet characteristics, and the program will estimate the performance of the fan installation.	Photographs of all planes, helicopters and ships that Boeing has built to date. All entries contain a photograph, a brief description and the history of the craft. Specifications, such as wingspan, length, weight, payload, engines used and thrust are also included. The program also has an "automatic page turner" for those who would like to browse.	Allows you to design any type of model, flying wings, canards, etc. from 4 inches to 720 inches. Will calculate CG, lift-to-drag ratio, neutral point and sink rate and will estimate weight depending on which material and flight power you use. The program will provide a performance evaluation and a planform, and it allows you to evaluate 60 airfoils.
Special features	Includes a motor library of very accurate data. Works with any gearbox, any gear ratio.	A program rewrite is in the works and will probably be available by the time you read this.	Many photographs are in color, and the program includes a "page marker" so that you can return to an entry of interest and a search facility that allows you to find particular types of craft, engine, etc . The program comes with a money-back guarantee.	Has storage and active files and a user's manual; menu-driven program.
Technical support	Contact programmer John Kress at (914) 366-4629 (voice), or e-mail at CompuServe ID: 76460,3715 or America Online ID: JOHNK8207.	Contact programmer John Kress at (914) 366-4629 (voice), or e-mail at CompuServe ID: 76460,3715 or America Online ID: JOHNK8207.	Online help; glossary of terms.	Phone for customer support (818) 775-1427.
Price	$69.50	$59.50	Free demo 5 diskettes—$29.95 plus $2 S&H	$88.75 plus S&H (CA residents pay sales tax). Specify disk size.
Order from	Bob Kress, Kress Jets Inc., 500 Ulster Landing Rd., Saugerties, NY 12477; (914) 366-8149, FAX (914) 366-5975.	Bob Kress, Kress Jets Inc., 500 Ulster Landing Rd., Saugerties, NY 12477; (914) 366-8149, FAX (914) 366-5975.	CodeX Software, Dept. H, 18719 78 Place W., Edmonds, WA 98026.	Design Files, 9675 Oso, Chatsworth, CA 91311; (818) 775-1427.

plus better programs; we may have a formula for success here.

We at *Model Airplane News* are interested in the extent of magazine coverage of computer topics you'd like to see. Tell us which of the programs surveyed here you'd like to see reviewed in depth. Also let us know of your interest in a survey of R/C flight-simulator programs. Contact executive editor Frank Masi at 251 Danbury Rd., Wilton, CT 06897; fax: (203) 762-9803; Internet: frankm@airage.com. Researcher Dave Garwood can be reached on the Internet at 70254.361@compuserve.com. ■

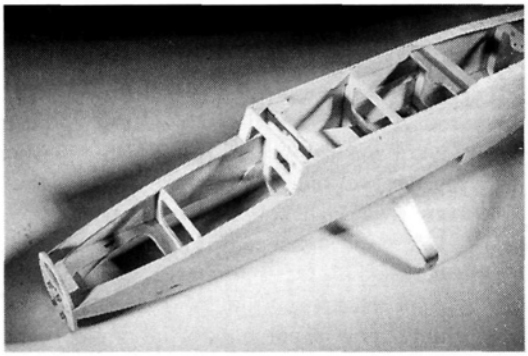
FIELD & BENCH REVIEW

BY BILL GRIGGS

GRAUPNER PARTENAVIA

An electric twin with power to spare

I'VE ALWAYS WANTED an electric-powered twin airplane, but somehow, I never got around to building one. When Tom Atwood offered me the Graupner Partenavia P-68C Victor as a Field & Bench project, I jumped at the chance. The Partenavia is one of the many kits that Hobby Lobby* imports from Johannes Graupner Models of Germany. Graupner kits are known for their high quality, good design and completeness.*



Interlocking construction keeps the fuselage nice and straight. The nose bulkhead locks to the formers to shape the plane's nose.

THE KIT

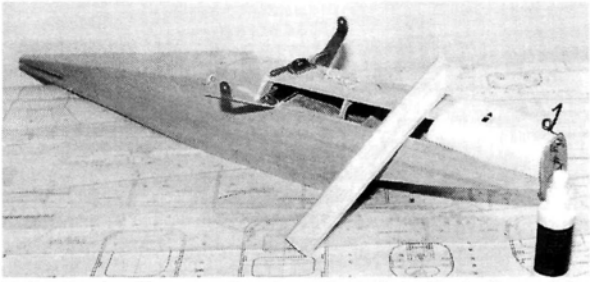
The Partenavia comes in a glossy box with a large photo of the completed model along with several construction shots. All the strip-balsa stock is bundled together with rubber bands while the sheet balsa and die-cut balsa are neatly stacked on the bottom of the box. Any parts that could get loose and damage the rest of the kit are taped to the box sides. The hardware package included such items as pushrods, wheels, hinge tape and wheel collars. Very few additional items are needed to complete the model.

The construction drawings are on two folded sheets. There is also a sheet with construction photos and German instructions and a separate instruction sheet densely printed in many languages. The directions' small print make it very difficult to find your place. I solved this problem by using a highlighter to cross off each step as it was completed. The English version of the instructions seems to have been translated by a person whose primary language isn't English, but if you take your time, you'll have no trouble figuring things out.

CONSTRUCTION

• **Fuselage**. Interlocking construction makes it nearly impossible to build a crooked fuselage. I used Satellite City* Hot Stuff UFO glues for the entire project. First, several doublers and triangle stock had to be added to the fuselage sides. The doublers were pre-slotted to receive the bulkheads and the lime-wood landing-gear mounting blocks. Next, I glued the three largest bulkheads into their slots on the right-side fuselage using a triangle to vertically align each bulkhead. I then aligned the left fuselage with the bulkheads and glued everything into place.

The nose bulkhead interconnects with four other formers to lock the nose of the plane into the correct shape. The rear of the fuselage is pulled together, and the rear bulkheads are glued into place, followed by the pushrod tubes, servo rails and rear sheeting (top and bottom).

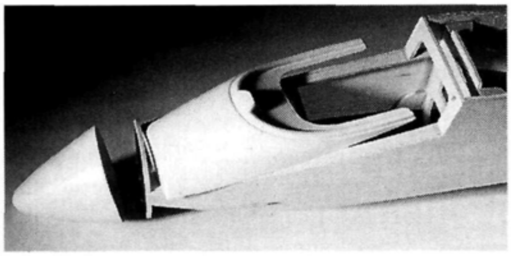


After the landing gear has been installed, the bottom of the fuselage is sheeted using beveled blocks of balsa. When the glue has set, the blocks are sanded to shape.

I then installed the landing gear and, using the beveled blocks supplied with the kit, sheeted the bottom center of the fuselage.

At this point, the fuselage looks bulky, and I was concerned that it might be overweight. Much of the balsa, however, is carved or sanded away in the next step, and the fuselage takes on a much smoother appearance—and loses quite a bit of weight.

The compound curves on the Partenavia are made of vacuum-formed plastic. I usually hate this kind of construction because of the amount of trimming needed to fit the parts properly into place. I was amazed when I discovered that the mold lines on the plastic parts were right on the money.



Vacuum-formed plastic creates the compound curves of the Partenavia's fuselage. The parts fit well and are lightweight.

I firmly glued the plastic pieces into place and then sanded the fuselage to final shape. If I were to build another Partenavia, I would simply tack-glue the plastic in place until the sanding had been done. Then, I would remove the plastic, paint it and cover the fuselage with film. I think this would be quicker than painting the fuselage, and it

SPECIFICATIONS

Model name: Partenavia P-68C Victor (GR4684)
Manufacturer: Johannes Graupner Models
Type: electric-powered sport twin
List price: $179
Wingspan: 52.5 in.
Wing area: 380 sq. in.
Sug. weight: 3 lb., 5 oz.; as built—3 lb., 8 oz. to 3 lb., 10 oz.
Sug. wing loading: 20 oz./sq.ft.; as built—21.22 oz./sq.ft.
Airfoil type: flat bottom with Phillips entry
Washout: none
Length: 37 in.
Motors: two Graupner Speed 400 7.2V motors (GR1794—$10.30 each)
Propellers: two Graupner 6x6 or Cox 6x4
No. of channels req'd: 3 (elevator, rudder, throttle)
Batteries: Graupner KR 1700 SCE (B071700E—$51)
Speed controller: Graupner Power MOS 30 BEC with brake (GR3275—$89)
Wing construction: built-up balsa, spruce, ply and lime wood
Kit construction: built-up balsa, ply, lime wood and plastic

Features: lock-together construction; extensive hardware package; decals; unique battery-mounting system with well-designed hatch; and pre-molded air scoops.

Hits
• Beautiful looks.
• Flat glide.
• Plenty of power.
• Kit quality and completeness.
• Battery-mounting system.
• Sound of twin motors.

Misses
• Slight torque-yaw problem.

Wishes
• Ailerons would be awsome!

FLIGHT PERFORMANCE

• Takeoff and landing

The Partenavia doesn't have a steerable nose wheel, but the rudder provides adequate control for takeoff. The Partenavia will take off from a paved runway, but not from grass. The plane tracks straight down the runway, but looks deceptively slow. Keep the plane on the ground, don't rotate early, and it will fly off with authority. On landing, the Partenavia has a fast, flat glide. The plane takes quite a while to come down, so you will probably over-shoot your first try. The plane shows no tendency to tip-stall, but you will need to control your altitude with throttle (just like a full-size plane).

The author prepares to launch the Partenavia on its second flight.

• High-speed performance

At full throttle, the Partenavia moves! The plane climbs under full power, so I tend to cruise at about three-quarter power and only use full power for aerobatics. There is one nit to pick: the Partenavia requires opposite rudder after a turn. When making a right turn, the plane is sometimes slow to return to straight flight. I think this is a torque problem that could probably be fixed with counter-rotating props.

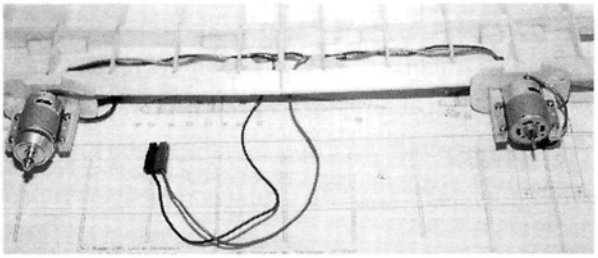
• Low-speed performance

The Partenavia has a flat glide and loses very little height. On the second flight with this plane, I caught a little bubble of thermal and gained some height at quarter throttle. I expected this plane to fall out of the sky when slowed down; I couldn't have been more wrong.

• Aerobatics

The Partenavia was not really designed for aerobatics, but it can be forced to do them. My plane has been looped from level light and will fly inverted with moderate deflection on the elevator. I did not try a spin or roll, but I have done wingovers with it.

The author finished the Partenavia using Coverite's 21st Century plastic film, primer and paint. MonoKote was used to add detail.

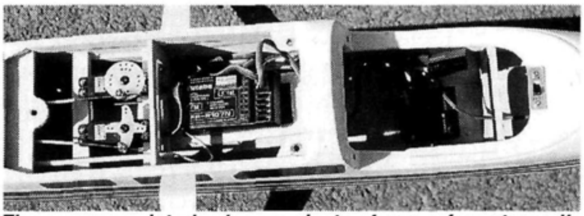


The constant-chord, flat-bottom wing also uses interlocking construction. Dowels align the lime-wood motor mounts with the leading edge.

would make the plane lighter.

• **Tail**. The tail surfaces of the Partenavia are made of sheet balsa and require little actual construction and only moderate sanding. The tips of the elevator have to be rounded and the control surfaces beveled.

• **Wing**. The wing has a constant chord and uses a flat-bottom airfoil with a Phillips entry. There aren't any ailerons, and the wing has a very shallow dihedral for a rudder-and-elevator ship. If you are an experienced builder, you could add ailerons to the wing with very little effort or weight gain. The Partenavia has power to spare, so ailerons would allow you to do wild aerobatics.



The cavernous interior leaves plenty of space for extra radio gear or batteries. Two Graupner/JR C3041 microservos and a Graupner Power MOS 30 speed controller (on floor of forward compartment) provide control. Batteries are mounted below the receiver.

To speed up building, the wing uses a "slot-together" construction. The wing spar is made up of a spruce cap and a hard-balsa web in which slots have been milled to accept the wing ribs. Both the leading and trailing edges are also slotted.

First, I pinned the spar and trailing edge into place and then I test-fitted the ribs. The slots in the ribs were too narrow to fit onto the spar without splitting, so I sanded the slots until I had a good fit.

After I had joined the two wing halves, I installed the lower leading-edge (LE) sheeting and dihedral braces. I routed the Jomar* wire that would be used for the motors, installed Sermos* connectors then sheeted the LE top and center sections.

The motor mounts are made from aircraft plywood with lime-wood mounting rails. Lime wood is similar to spruce, but it's much easier to carve. I wish Graupner would export this wood to the U.S.

Dowels are used to align the motor mounts with the LE, and screws secure the mounting rails to the spar. The motors are held to the rails with metal cradles and cable ties.

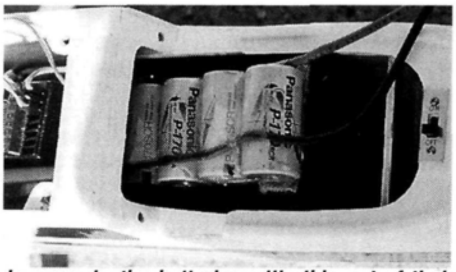
FINISHING

I used Red Devil* Onetime spackling to fill imperfections in the balsa and in the seams of the plastic. I then sanded the balsa with sandpaper of progressively finer grit. The plastic parts were lightly sanded with 600-grit. I then vacuumed the dust off and wiped everything down with a tack cloth.

I used Coverite's* 21st Century primer and paint for the fuselage and the plastic parts. The paint was easy to use, and it covered well. The 21st Century paint allows you to spray on a new coat every three minutes, and it's fuelproof in only 12 hours. The paint has a very strong odor, so you should only spray it outdoors or in an area with super ventilation. I bought a respirator and now would not spray-paint without wearing it. I think the $25 cost of a respirator is a lot cheaper than the hospital bills that would follow paint-fume inhalation.

I covered the wing and tail with 21st Century plastic film. The color match is very good, and the film really goes around curves nicely. I used MonoKote trim sheets for the blue trim and automotive trim for the gold. The decals were put on with water and squeegeed into place.

My model came in 4 to 5 ounces heavier than the recommended weight. This is probably because I put on a few extra coats of paint for a really nice finish. The plane isn't really affected by this extra weight. Just be aware that you can build this plane lighter.



In a crash, the batteries will slide out of their tray and through the hatch—totally avoiding your expensive radio gear.

FINAL ASSEMBLY

The wing was drilled for the mounting bolts and the fuselage was drilled to accept the blind nuts. I suggest that you discard the included wing bolts and blind nuts and replace them with the American equivalent, because metric nylon bolts are almost

impossible to find.

With the wing in place, I mounted the horizontal stabilizer and checked its incidence. When I was satisfied, I glued it into place with UFO thick CA. I checked the alignment of the vertical stabilizer with a triangle, and then glued it into place.

The elevator and rudder are hinged with a special tape that's provided with the kit. The hardware package includes some unique control horns that have little wedges that allow the horns to sit level on a beveled surface. Nice!

RADIO INSTALLATION

The servo rails are put into place when the fuselage is constructed, so radio installation is a snap. I used Graupner/JR C3041 microservos for elevator and rudder control, and I used a Graupner Power MOS 30 BEC proportional speed controller. The MOS 30 is low-rate, optically coupled, has a brake, will handle up to eight cells at 30 amps and weighs 1.7 ounces.

The fuselage has a neat battery holder that lets the battery slide out through the hatch on a hard landing, totally avoiding your expensive servos and receiver.

The motors used in this project are two Graupner Speed 400 7.2V motors. These are inexpensive little powerhouses. I used a 6x6 Graupner prop and a Graupner 7-cell, KR-1700 SCE, 1700mAh pack. With this combination, the current draw was 9 amps. I also used a set of Panasonic P-170 SCR 1700mAh cells and a set of SR 1500mAh Max cells. All give good long flights. (After my positive experience with Speed 400 motors on this project, I designed three models around this motor.)

CONCLUSION

The Graupner Partenavia is a really super kit that shouldn't give any experienced modeler a problem. Bob Powers, the pilot for the flight shots, is an experienced pattern flier, but he has no real electric experience. Bob loved the way this plane grooved. The plane has plenty of power and might be considered hot by some pilots. Bob felt that because of the high wing loading, the Partenavia behaved like a similar sport glow-powered plane.

Hobby Lobby claims that anyone who has soloed a Telemaster can fly this plane. Well…maybe; but I think this should be perhaps your third plane, because it is a tad fast. Although the Partenavia is a bit pricey ($179 retail), I feel its quality and completeness more than justify its price. If you can't tell: I'm really happy with this kit!

**Addresses are listed alphabetically in the Index of Manufacturers on page 177.* ■

FIELD & BENCH REVIEW

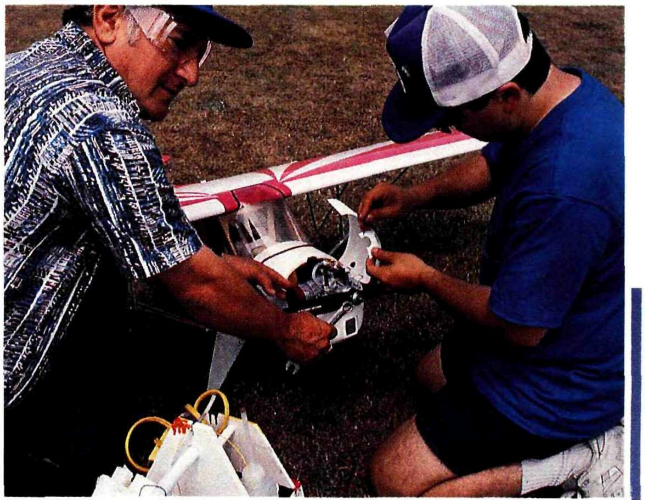
ISC/Indy International Clipped-Wing J-3 Cub

A high-quality, yet inexpensive, giant-scale aerobatic trainer

by ROB WOOD

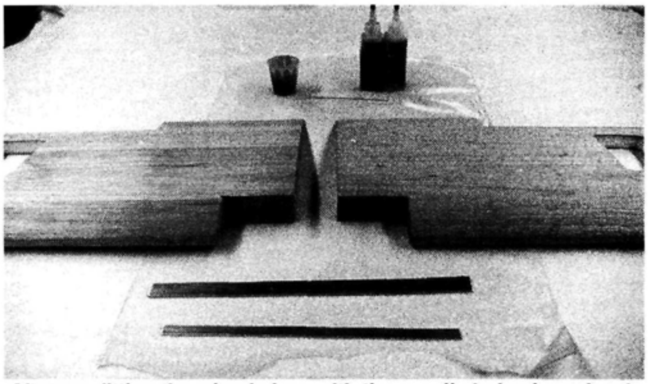
THE J-3 CUB is arguably the most popular airplane of all time. Its friendly yellow paint scheme, diminutive size and forgiving nature make it a natural trainer, and thousands of pilots who won their wings in the back seat will attest to the Cub's durability and dependability. This love affair with the Cub is quite evident in the modeling world as well, with literally dozens of different manufacturers presenting their versions of the venerable workhorse.

It is a truism that the closer in size a model comes to its full-scale counterpart, the more closely the model will emulate the flying characteristics of its subject; and this clipped-wing Cub from ISC International is a case in point.



Marco Pinto and his father, Enrique, concentrate on final tweaking before the test-flight.

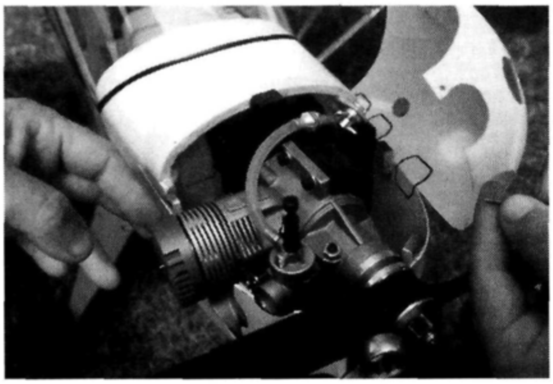
THE KIT



After pre-fitting the wing halves with the supplied aluminum brackets, the wing assembly is ready to be permanently joined with slow-curing epoxy. The halves matched perfectly.

The ISC* Cub is an almost-ready-to-cover (ARC) kit, with balsa-sheeted foam wings and a built-up balsa and ply fuselage, and is an improved version of ISC's previous Cub offering. The first thing we noticed upon opening the box was the top-quality nature of the construction: every part is straight, light and beautifully sanded. The leading edges of the wings, stab and control surfaces are almost perfectly radiused and are truly ready for covering.

The second thing we noticed was the size of the parts: this is a big airplane! With its 79.25-inch span and 62-inch fuse length, I was sure the kit would arrive in two boxes, but since the wings are shipped as two halves, the entire kit fits into one UPS-shippable box and is packed securely. The kit comes with a basic hardware package but, as the first page of the modest instruction manual points out: "It will be necessary for you to buy some of the hardware, or you may wish to use some other brand of hardware." We substituted 30-inch fiberglass pushrods with 4-40 threaded rods for the balsa pushrods included in the kit, and we replaced the clevises with 4-40 Gold-N-Clevises. The servo mounts are designed for standard servos and, as we had decided to use ¼-scale servos, those were modified as well. The rest of the hardware package was quite sufficient to do the job.



The ASP 1.08 engine fits snugly inside the fuselage. It can be accessed through the hinged hatch.

CONSTRUCTION

The first step we took was to carefully examine each piece of the kit, searching for any cracks or faulty joints. We found one joint that we felt was insufficiently glued, but a few drops of thin CA took care of that, and construction was underway. The instruction booklet starts you out with trial fitting the two wing halves by joining them with the supplied aluminum wing braces. The joint was nearly perfect, with no align-

SPECIFICATIONS

Model name: Clipped Wing Cub
Type: high-wing sport plane with modest aerobatic capabilities
Manufacturer: ISC International
List price: $349.95 plus S&H; $469.95 (already covered)
Wingspan: 79.25 in.
Wing area: 1,147 sq. in.
Weight: 12.4 lb.
Wing loading: 24.9 ounces per square inch
Length: 62 in.
Engine: ASP 1.08
No. of channels req'd: 4 (aileron, elevator, rudder, throttle)
Radio used: JR* Max 6 PCM
Kit construction: built-up balsa fuselage and stab; balsa-sheeted foam wings

Hits
- Beautiful craftsmanship; strong but light; parts fit is superb
- Generous hardware package
- Easy assembly
- Great flying machine that takes off in 15 feet and lands lightly and slowly
- Head-turning quotient (HQ): 95 percent

Misses
- Instructions could be a bit more detailed, although this did not affect our building process.

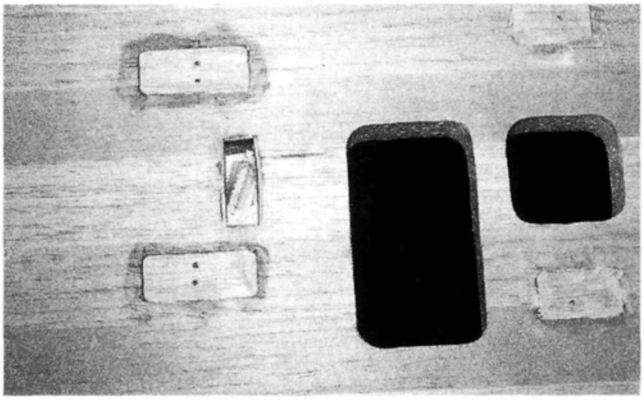
FLIGHT PERFORMANCE

• Takeoff and landing
The Cub handles like a typical tail-dragger. Give it a little down-elevator when taxiing downwind, and just a touch of up-elevator in the takeoff roll. The Cub's big rudder will give you rudder authority at very slow speeds, so ground handling is a breeze. This Cub ROGs in less than 20 feet! The landings are just as simple. Chop the throttle, and it will float right to the runway.

• Low-speed performance
The Cub was designed for low speeds; stalls are almost out of the question for typical flying speeds—even in the landing approach—and should not be a concern. Remember to coordinate the aileron turns with the rudder; do that, and you can slow this Cub down to a walk.

• High-speed performance
The Cub is not designed for high speed, and the only caveat I'll throw in is this: fly the Cub in a scale-like way, and you (and your Cub) will be happy. Hotdog it with a really big engine, and you'll run the risk of an inflight structural failure.

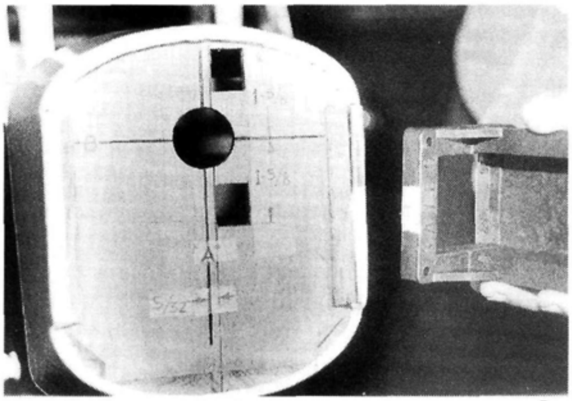
• Aerobatics
We put this Cub through the basic IMAC maneuvers and were pleasantly surprised with the results. This Cub can do them all! Inverted flight requires almost no down-elevator at all, and the 1.08 supplies plenty of power for vertical maneuvers such as stall turns and Immelmanns. Since the Cub doesn't want to stall, spins are hard to initiate, but are possible. The Cub proved to be extremely stable in vertical maneuvers, and it showed no tendency to fall off to the side.



All strut mounts are glued into place, and the aileron servo compartments have been enlarged to take the ¼-scale servos.

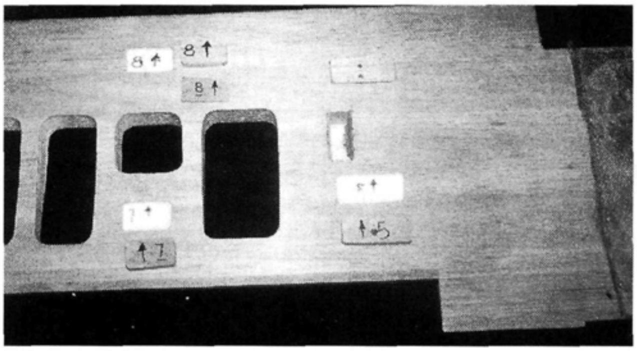
ment problems. The second step is to ensure that the servo wells in the wings will accept the servos you plan to install, as modifying these wells after joining the halves would be extremely difficult.

Since the Cub comes prebuilt, the construction process could more accurately be described as an assembly process, with little or no work involved in making the parts fit. We simply followed the booklet step by step and found no mistakes. The manual does point out that the kit is not for beginners and, thus, does not include highly detailed instructions; however, the instructions could stand a little more detail, even for builders with intermediate skills.

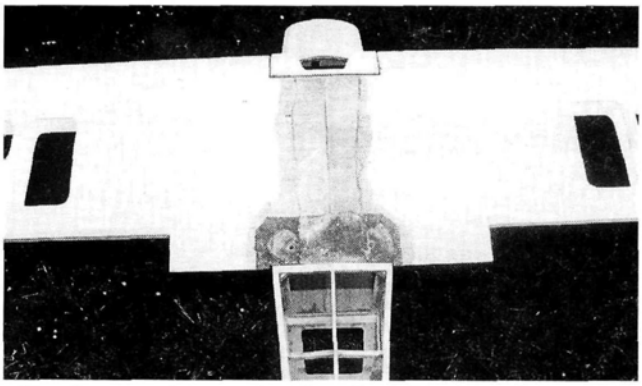


The holes provided for the wooden engine mount were 5/32 inch off-center. The manufacturer had no explanation for this (I called), but we had decided to install a glass-filled engine mount instead of the wooden rails, so the holes' positions posed no problems.

After assembly had been completed, we covered the airplane with pink and white MonoKote* and installed an ASP 1.08 engine, also from ISC International. Although the kit specifies a 2-cycle range from .75 to. 90, we felt that aerobatic maneuvers would be marginal with the power available from a .90 and decided on the bigger engine. As we were interested in maintaining a scale appearance, we were happy to receive and test a new Slimline Pitts-style muffler (no. 6021) designed for ASP .90 to 1.08 engines. This muffler fits completely inside the cowl and works quite well. With the engine installation complete, we installed a JR* radio, range-tested the system and were ready to fly. The entire project had taken less than 40 hours!



After test-fitting the plywood strut-mounting plates to the wing, the strut assemblies are placed in position, the bracket holes are marked, and blind nuts are installed on the undersides of the plates. The plates are then epoxied to the foam-core and balsa skin.



After the epoxy has cured on the wing joint, strips of glass cloth and carbon-fiber cloth are epoxied to the joint for additional strength. [Editor's note: fiberglassing is not necessary for regular flying.]

CONCLUSION

If you like big Cubs, want an easy-building, great-flying and stable high-winger, this ISC International offering will fit the bill.

**Addresses are listed alphabetically in the Index of Manufacturers on page 177.* ■

n Zdon of Minneapolis, MN, shows us how far you can take a Goldberg imate if you have the desire. Completely matched with a set of Scale Model search three-views, the Ultimate is a sure contest winner. It's powered by a per Tigre .90 with a 14x8 prop.*

Getting into SCALE

by Frank Tiano

Here's a P-47 that was built by Bill McCallie. This Yellow Aircraft kit is one of the most stable WW II models you can find. It weighs 22 to 24 pounds, and it flies well with 1.5 to 2.5 cubic inches of glow or gas power.

The hardest part is choosing what to build

AND LADY LUCK has really shined on you—many years ago, there were very few scale kits or plan packs and now, we have several hundred from which to choose. Whether your stes lie in military or civilian, there's gobs of stuff in different sizes hat will satisfy almost anyone.

For example, let's take a look at some of the easy-to-build, stable lying civilian aircraft with which I personally am familiar. Cubs are ice, and they're as stable as can be, but maybe you'd like something

Mark Murdock of Jonesboro, GA, built this hard-to-find, easy-to-build-and-fly Top Flite P-39 Airacobra. It's a great first-time scale entry, as are Top Flite's new Corsair and P-51 Mustang.

a little different. Pica Enterprises* in Miami, FL, offers two different size Cessna 182s and an Aeronca Sedan that look and fly great. They require a little extra care when building, but the finished product is worth it. Ace R/C* has several Extras and a really neat Taylorcraft. The T-Craft is fully aerobatic, but again, you need to enjoy building cause it's got a whole lot of sticks. If you'd rather stay with a .60 model for your first scale contest, Sig Mfg.* offers quite a few scale models, many of which are aerobatic, civilian types. All of Sig's designs are fine performers, and I've never heard a bad word about any of their kits. A Smith Miniplane, a Ryan STA, a Liberty Sport, a Skybolt and, of course, the popular Piper Cub are in their current inventory. Carl Goldberg Models*, not to be left out, also offers a Cub, a great flying Extra and a superb Ultimate biplane. They're all-balsa models; to make the cowls and wheel pants last longer, you should consider replacing the kits' parts with an aftermarket fiberglass cowl and wheel pants.

If you prefer larger-scale models, you can find several at Ikon N'wst*. These are builders' kits that feature balsa-and-ply construction, and some have a fiberglass cowl and/or wheel pants. Ikon offers plans as well as kits for most of their designs, which include a Curtis Robin, a Monocoupe, a Corben Super Ace, a Ryan PT-22, a Sperry Messenger and a host of others. Ikon N'wst even has a deHavilland Beaver—a plane I've always thought would make a neat scale model.

Pat McCurry has been flying this Byron P-51 for three years. It's powered by a Quadra 42 with a prop drive and four-blade prop. Pat says "It's an honest airplane—just don't stall it!"

FIGHTER WINGS

Now some of us prefer the go-fast, shoot-'em-up, bang-bang sounds of "heavy metal," and others prefer simple warbirds of a different nature. Well, there are plenty of those out there, too. If you prefer biplanes, Proctor Enterprises* has several WW I ships in addition to a fabulous Curtis Jenny. They all fly as nice as you could hope for. Dave Platt Models* offers a nice, ¼-scale Jungmeister that's right on as far as outline is concerned, and is aerobatic as can be. There are more kits and plans out there for the single-wing crowd—typically, WW II aircraft—than you could shake a broken prop at.

Royal Products* has an enormous selection of scale models, but I've only seen their KI-61, P-38, B-25, C-47, Corsair and P-51, which fly well. Royal kits have been around for almost 20 years, and they're still constructed of heavy plywood and balsa; this leads to a somewhat higher wing loading than you might hope for or expect. For entry-level competition, however, I think you'll be OK if you pick a plane with a lot of wing area. Best of all, Royal has several airplanes that come in two or three scales; i fact, their Corsair comes in four sizes!

Byron Originals* also provides impres sive, good fliers as first-contest airplanes Although they aren't known for true-to-scal outlines, Byron's kits are relatively easy t assemble, and they certainly fly up a storm Although they cost a little more to start with they have proved to be a rugged, long-last ing investment. Byron offers several war birds, such as the P-40, the Hellcat, th Corsair, the Zero, the Thunderbolt and, o course, the ever popular P-51 Mustang. Yes they have civvy stuff, too: a great Beec Staggerwing, a Ryan STA, a Glasair and a Husky—just to name a few.

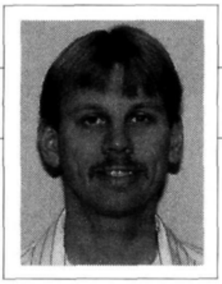
Yellow Aircraft* still offers the old Ber Baker designed P-47, Zero and P-38 in a updated kit form, and they've got a prett decent Cap 10 as well. Both Byron and Yellow kits feature fiberglass fuselages and foam win construction. If you'd like an all-balsa kit, Dav Platt Models is about the only company left tha offers 80-inch models. His inventory includes a P-51, a Supermarine Spitfire, a Focke Wul 190A-8, a Japanese Zero and an ME-109G. Al of Dave's designs are about as close as yo could hope for in the outline department; an they fly well, as many Masters, Nationals an Top Gun pilots have proven.

If you prefer balsa kits that are intended fo

(Continued on page 148

"It doesn't get much better than this!" Here' Charlie Chambers' Big Beautiful Doll P-51 from a Dave Platt kit. This all-balsa kit is covered wit aluminum. It weighs 23½ pounds, and it's pow ered by a Moki 1.5.

CENTER ON LIFT



MICHAEL LACHOWSKI

SOARING TIPS

THIS MONTH'S COLUMN is a collection of small items that you might want to consider. Many times, it's the details, practice and preparation that improve the performance of both pilot and sailplane. I want to tell you about 5-cell flight packs for flying; the ever-controversial landing aids; and some really nice parachutes. Finally, the most important topic is backing up computer-radio settings.

5-CELL FLIGHT PACKS

Do you need more nose weight and want snappier control response? Just add another cell to your flight pack, and you're in business. If you've ever looked closely at a top pilot's airplane, you'll probably find a 5-cell pack. This includes sailplanes, pattern, or any other type of flying.

After making this modification, the first thing you'll notice is quicker servo response. Servos will move a little faster and will have much more power. Those flaps that never seem to come all the way down will move with authority. Flap response at high speed improves with the extra power. Many models can't drop flaps all the way down at high speed because of the air loads. Your model now responds quicker to your control inputs.

The downside to using a 5-cell pack is power consumption. With a higher battery voltage, you have higher currents and a shorter battery life. Unless you're using high-capacity cells, the shorter battery life might surprise you. You'll want to use 900 or 1000mAh cells instead of the usual 600mAh cells.

Most modern radio equipment will work just fine with the higher voltage of a 5-cell pack, but you probably should check with your radio manufacturer to be sure.

LANDING DEVICES

One easy way to start a controversy among sailplane pilots is to discuss landing skids, skegs, sharks' teeth, or other landing devices that you dream up.

If you haven't yet tried one, a landing skeg is a very effective device. If you're not the competitive type, and you're wondering what I'm talking about, a skeg looks like a small fin on the bottom of the fuselage that's usually located behind the wing.

Landing skegs work in two ways: first, the fin itself drags through the grass to slow the plane. Because the fin is thin, it goes all the way to hard ground—something that definitely stops airplanes. Second, the fin helps ensure that the nose won't come up. This prevents the wing from generating upward lift and causing the glider to slip across the landing area. Nothing is more aggravating than when the nose hits the landing stake and the plane bounces and skips out to a 70-point landing.

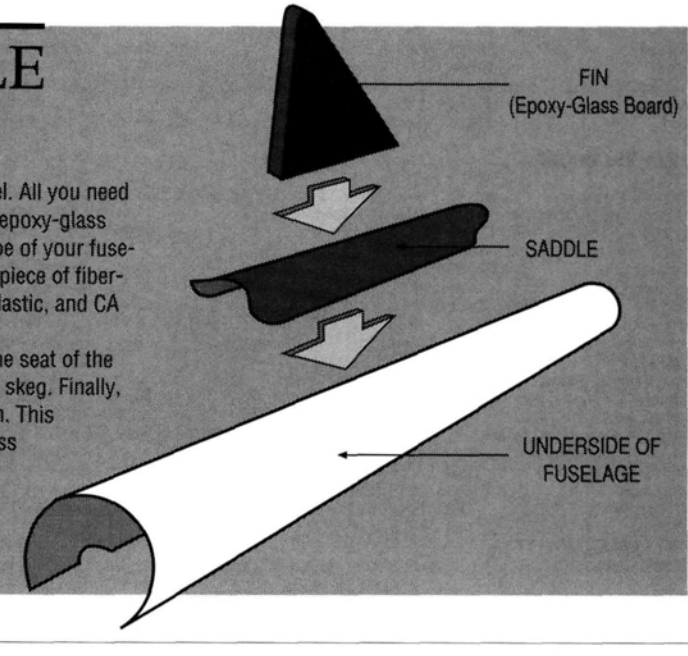
GREAT PARACHUTES

Almost every parachute I've used has multiple panels sewn together, shroud lines tied or sewn together and an opening on the top where the tow ring is attached. I've had parachutes tear along stitching and shroud lines break, and every parachute has ended up with tangled shroud lines and tow rings tangled somewhere in the top of the chute. Now you can get a parachute without

MAKE THIS SIMPLE LANDING SKEG

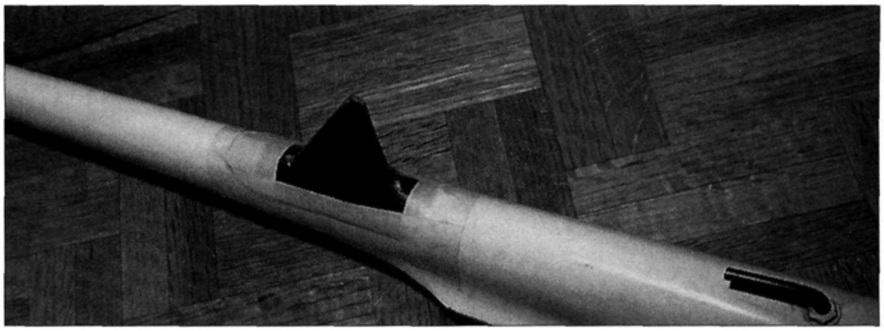
Landing skegs are easy to make and to try without changing your model. All you need is some epoxy-glass board, fiberglass, carbon fiber and epoxy. Cut the epoxy-glass board to the shape of the fin. Make a seat for the fin that fits to the shape of your fuselage. Put some plastic over the fuselage bottom behind the wing. Cut a piece of fiberglass cloth larger than the saddle you want to make, drape it over the plastic, and CA the fin to the fiberglass. Now mix up some laminating epoxy.

Use some carbon-fiber tow or cloth to create a fillet, and reinforce the seat of the skeg on the fuselage. The carbon fiber should extend fore and aft of the skeg. Finally, build up a few layers of fiberglass cloth over the carbon fiber and the fin. This firmly attaches them to the seat. Let everything cure, and trim any excess fiberglass around the seat. Now you have a skeg that you can tape on whenever you need it.



PHOTOS BY MICHAEL LACHOWSKI

A landing skeg is a simple way to shorten landing distances. The fin-shaped device is made of epoxy-glass board, fiberglass, carbon fiber and epoxy.



The skeg is attached to the underside of the fuselage with tape, so it can be easily removed and installed without modifying the sailplane.

any of these problems. The New England Parachute Company* makes parachutes that feature only one shroud line, which eliminates entanglement and prevents the chute from becoming inverted. Instead of being attached to multiple shroud lines, the chute is held by netting, which then is attached to the one shroud line. The netting and canopy also make it more visible than conventional parachutes. Topping it off is a plated steel ring that's better than any I've used. Best of all is the bargain $15 price tag.

RADIO BACKUP

More and more pilots are using computer radios. Advantages like built-in mixing programs, centering and travel-limit adjustments and preset flight conditions are wonderful tools for getting the most out of the current generation of sailplanes. All this programming is valuable data. Have you backed up your data lately? Normally, the equipment is very reliable. You don't expect something to happen to your program. User error or even the rare equipment failure might wipe out your programming.

Unfortunately, most computer radio manufacturers don't provide us with an easy way to back up, store old copies, or even exchange mixing programs. I always have to re-enter programs for my slope ships because I don't use them that often, and I don't have enough program space for everything in my fleet. You don't need a computer to create backup copies. All you really need are a sheet of paper and a pencil. Get out your transmitter manual and check to see if it includes a program template. Make some copies, and write down all of your transmitter settings.

Manufactured by The New England Parachute Co., the parachute is made of material that's similar to that used in full-size chutes.

I use a computer spreadsheet to store my data. The spreadsheet is nice because I can tailor it to the model configuration and options I'm using on that model. For my Vision, it takes the form of a series of columns with all the menu items and values. It doesn't take long—only a few minutes per program.

I hope that the radio manufacturers get smart and start providing us with computer interfaces. This will be especially important for radios that can control the control and mixing curves. We don't need expensive modules or options for 100 programs. We just need a computer interface for recording and restoring the data.

*Addresses are listed alphabetically in the Index of Manufacturers on page 177. ■

MONARCH MISTAKE

On page 121 of our November issue, in Michael Lachowski's article on the World Soaring Jamboree, we erroneously cited the Monarch hand-launch sailplane as being distributed by Slegers International. The Monarch, manufactured by D. G. Aerotech, is exclusively distributed by Northeast Sailplane Products, 16 Kirby Ln., Williston, VT 05495; (802) 658-9482. We regret any inconvenience this error has caused.

BONUS GUIDE TO—

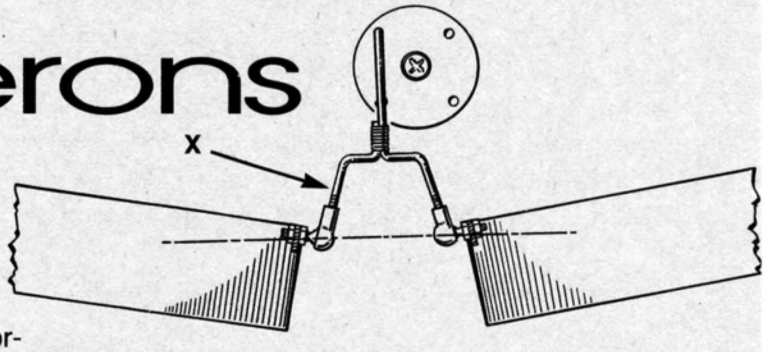
Control Mechanisms

Improve performance with these simple tips

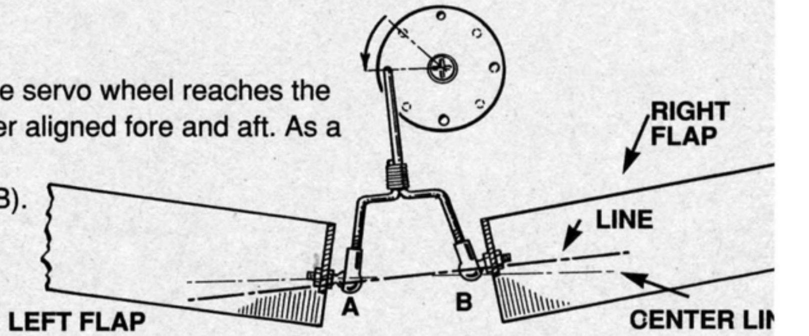
There's more to building the perfect plane than frame-up and covering. If the mechanisms that control your model's functions aren't set up properly, disaster will almost surely follow. Here are some tips to help ensure that your plane's control surfaces and landing gear perform successfully.

ARTICLE & ILLUSTRATIONS by JIM NEWMAN

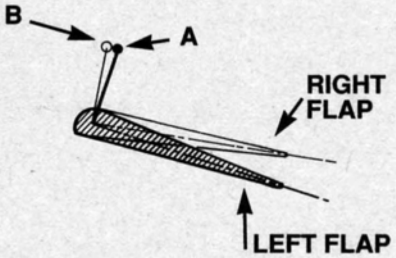
flaps & ailerons



■ **Figure 1(a).** This is the flap linkage most commonly seen on sport planes, and it has a serious pitfall. The drawing has been somewhat compressed for space considerations, the servo generally being much farther forward. Consequently, the arms (X) are, in reality, much longer.

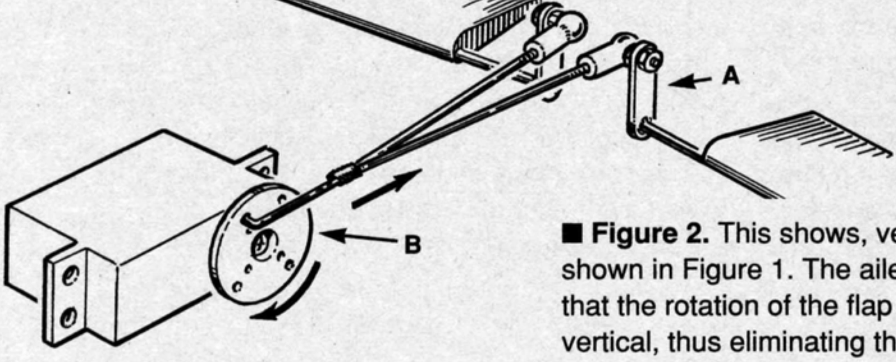


■ **Figure 1(b).** As can be seen here, when the servo wheel reaches the 9-o'clock position, the flap pushrod is no longer aligned fore and aft. As a result, a line drawn through the two ball joints (A) and (B) shows that (A) is farther aft than (B).

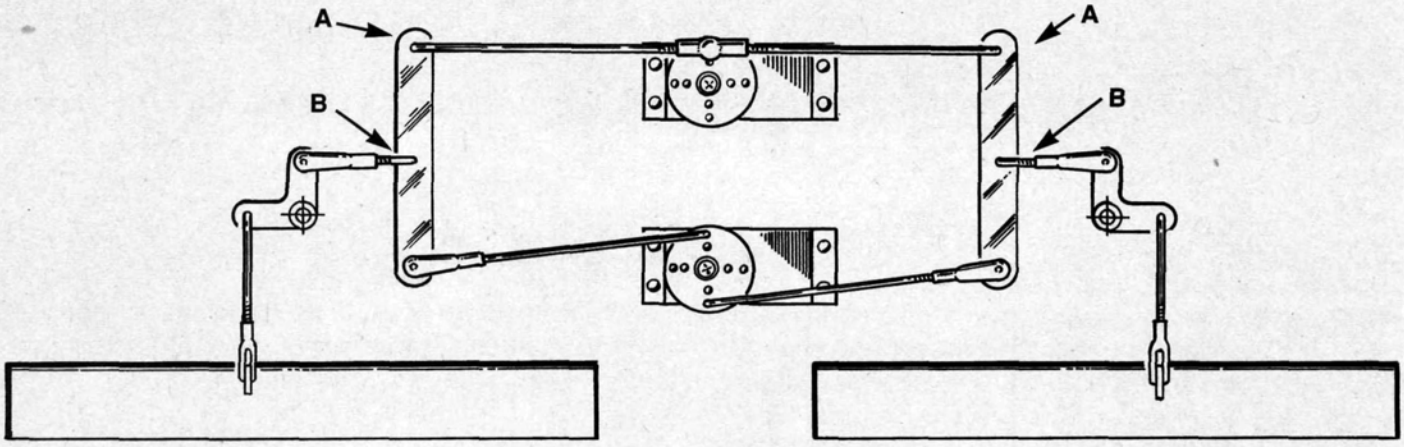


■ **Figure 1(c).** The reader can plainly see from the positions of (A) and (B) (shown in side view) that the left flap is lowered farther than the right; and if a flier is in the habit of leaving flap deployment until he has only minimal altitude, he could be in for a surprise, because his model starts a roll when he least expects it.

. . . .

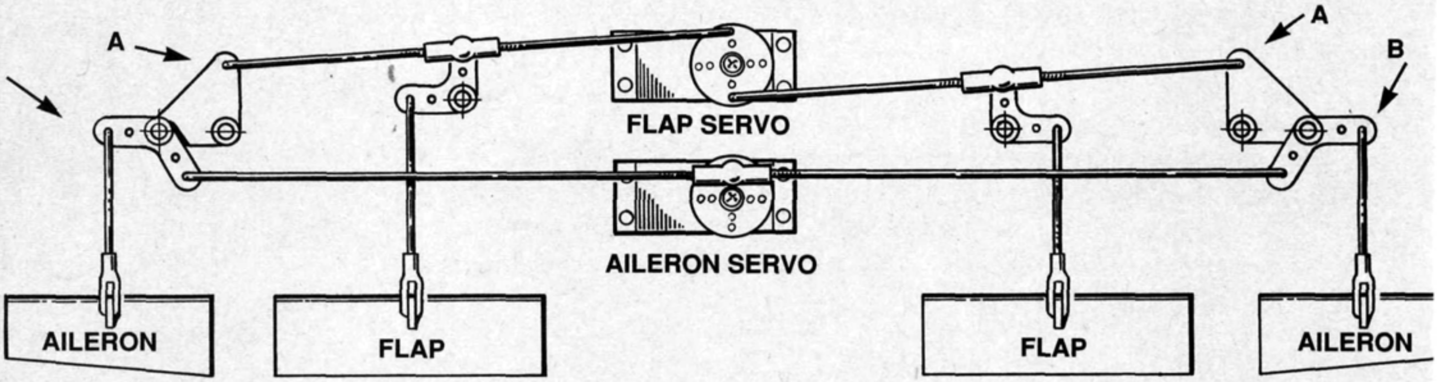


■ **Figure 2.** This shows, very simply, how to eliminate the problem shown in Figure 1. The aileron servo is merely turned on its side so that the rotation of the flap horns (A),and the servo wheel (B) are both vertical, thus eliminating the side-to-side motion of the flap pushrod.



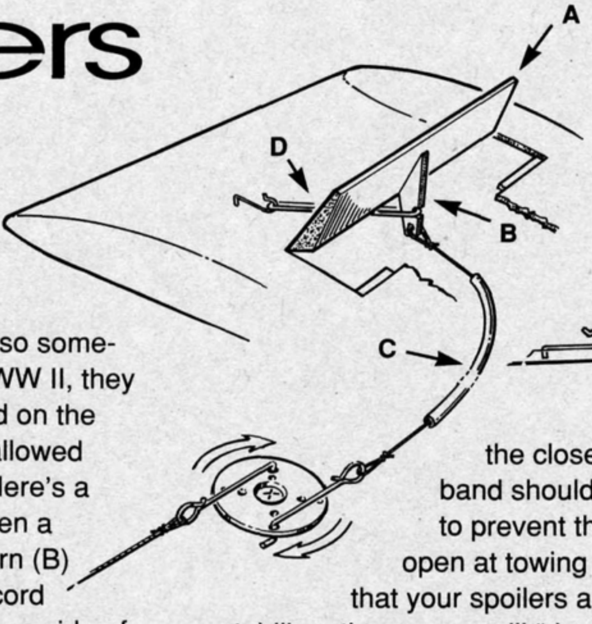
■ **Figure 3.** Here's how to make those long strip ailerons do double duty as flaps. Add a second (flap) servo as shown, the mixer levers (A) and the pushrods (B). To see how the mechanism operates, just consider either of the servos stationary, then follow the motion of the remaining servo and its pushrods. Reverse the procedure for the other servo. Even when the ailerons are lowered to do the duty of flaps, they will still function normally as ailerons. The mixer levers should be cut out of nylon or thick Formica. To figure the lengths and movements needed, make a card-strip and thumb-tack mock-up on the bench.

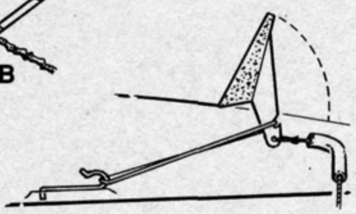
. . . .



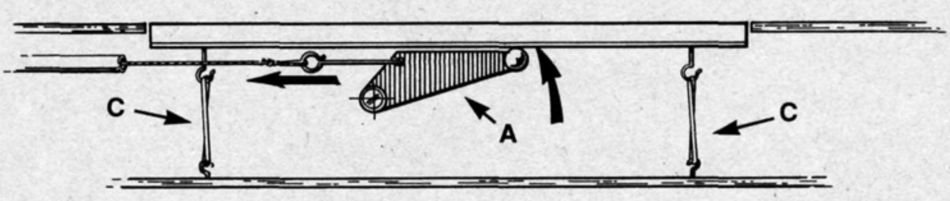
■ **Figure 4.** On some full-size aircraft, such as the Helio Courier and the Miles Messenger, when the flaps are lowered, the ailerons are also lowered, but only to about 30 percent of the amount of the flap deflection. This preserves washout when you most need it at the bottom end of the speed range. This seemingly complicated mechanism lowers both flaps and ailerons, and to see how that works, just consider the aileron servo to be stationary, then follow the movement of the flap servo and associated pushrods. All that really happens is that the bellcranks (A) rotate outward and push the regular aileron bellcranks (B) backward, thus driving both ailerons down. Experiment with a cardboard mock-up on the bench to obtain the various crank throws required.

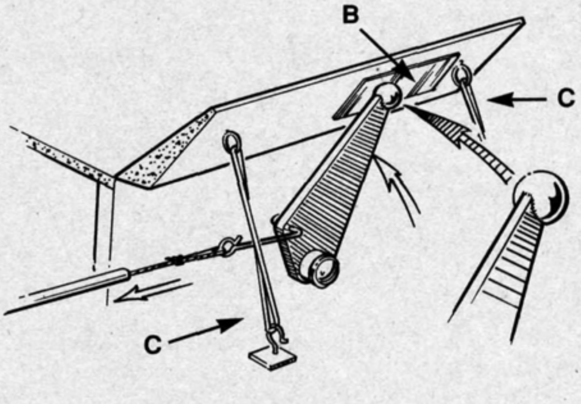
spoilers



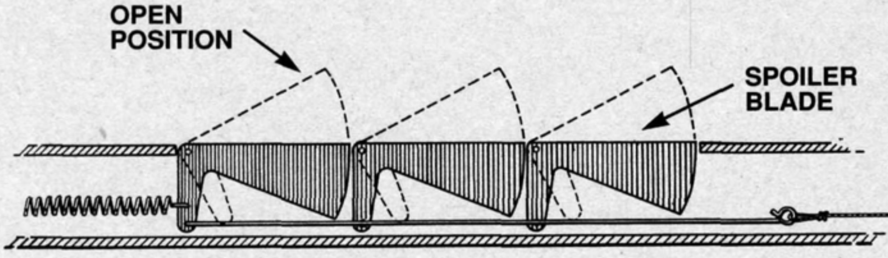


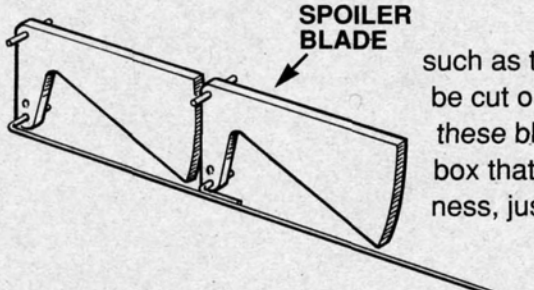
■ **Figure 5.** Spoilers offer a very safe way to lose altitude, but not gain unwanted speed while doing so. Mostly seen on sailplanes, they are also used on some powered aircraft—airliners in particular, where they are also sometimes known as "lift dumpers"! During WW II, they were installed on the Taylorcraft L2 and on the Waco CG-4a combat glider, and they allowed these aircraft to get into tight spaces. Here's a simple spoiler, the blade of which is often a piece of trailing-edge stock (A). The horn (B) is pulled back by a Dacron line or dial cord that runs through a plastic tube (C) to one side of the spoiler servo wheel. A light rubber band (D) returns the spoiler to the closed position. Note: the band should be just tight enough to prevent the spoilers sucking open at towing speeds. Make certain that your spoilers are well outboard of the stabilizer tips, or you will "drown" your elevator in turbulence.



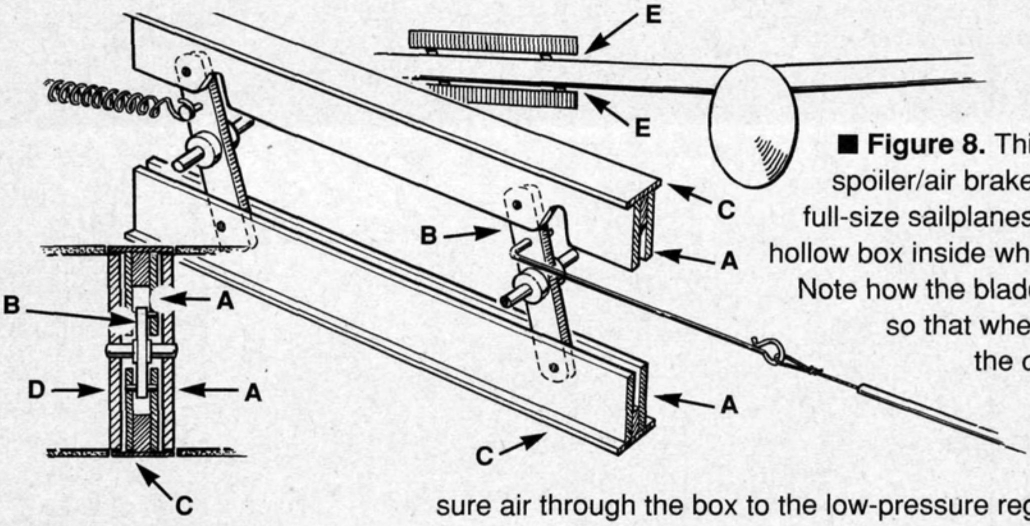


■ **Figure 6.** This is the same type of spoiler as the one shown in Figure 5, but it's operated by a ball-ended crank (A) bearing against a hard plastic plate (B) on the underside of the spoiler blade. The ball is a large plastic bead with a slot sawn in it, and it's CA'd to the crank. Rubber bands (C) still provide the closing force. The main advantage of this layout is that the builder does not have to find room for a plastic tube with a large, sweeping curve in it.



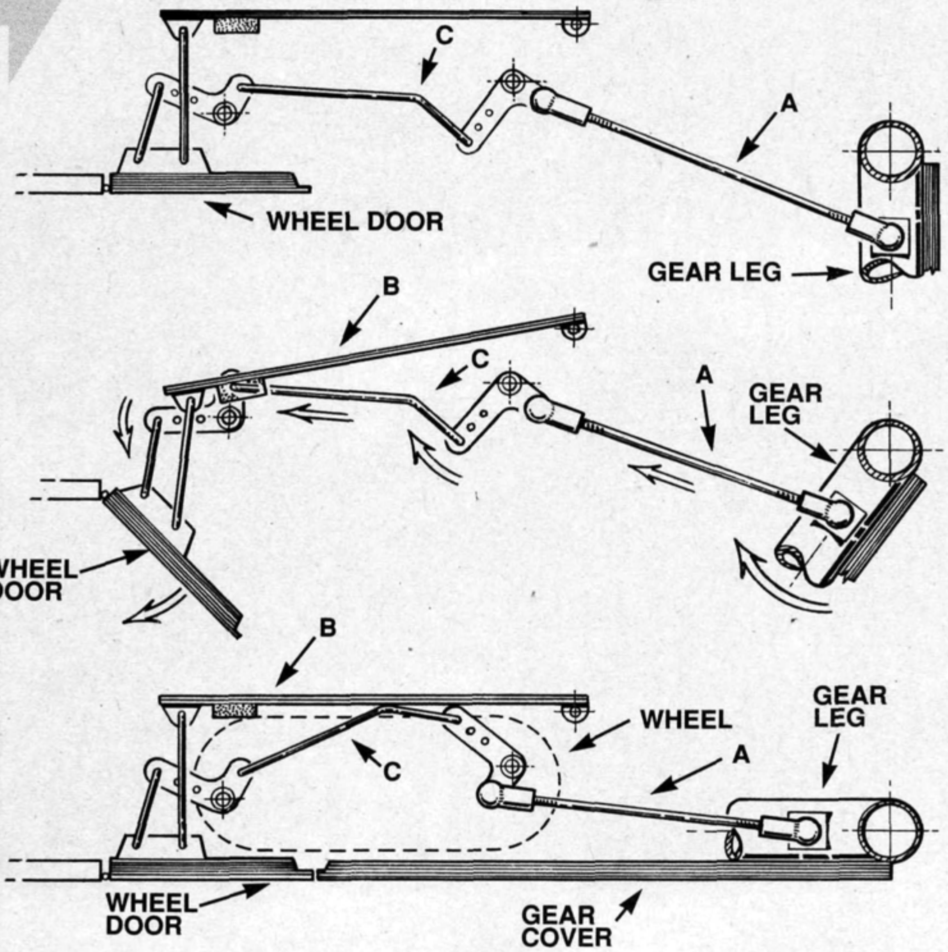


■ **Figure 7.** The latest in spoiler fashions—seen on some high-performance aircraft, such as the Mooney 201. These saw-tooth spoiler blades can be cut out of thick plastic or printed-circuit board. Ideally, these blades should be installed in a long, close-fitting spoiler box that also serves as a guide. To increase spoiler effectiveness, just keep adding "saw-teeth."

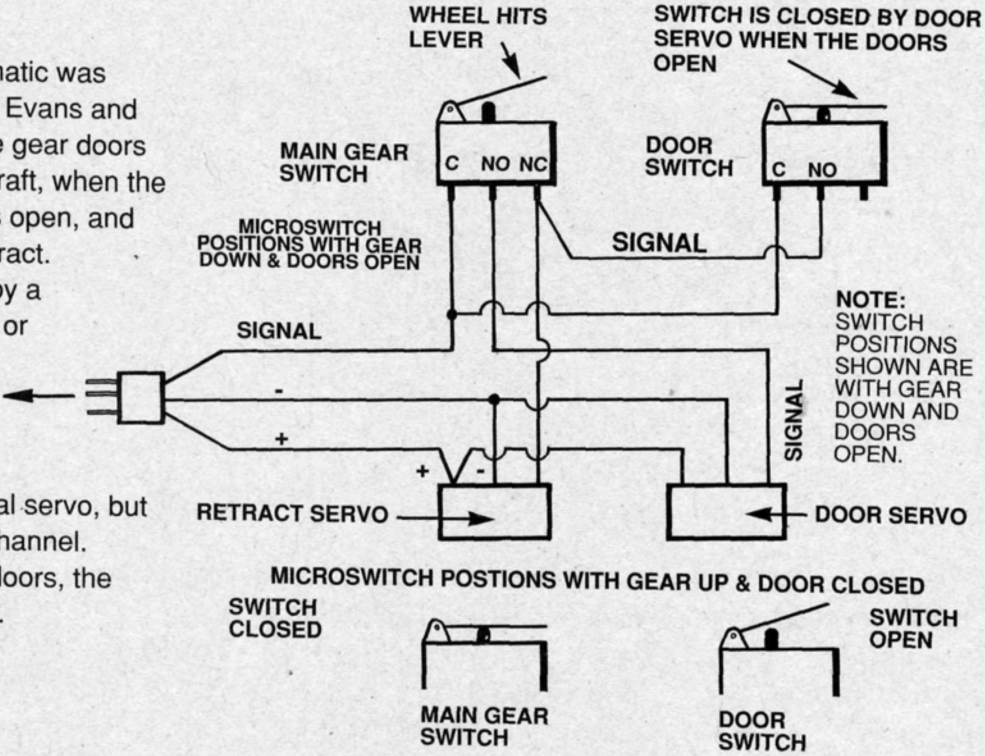


■ **Figure 8.** This is the Schempp-Hirth spoiler/air brake seen on some vintage, full-size sailplanes. Each spoiler blade (A) is a hollow box inside which are the spoiler arms (B). Note how the blades are capped (C). This is so that when the spoilers are closed, the caps seal down on the edges of the spoiler box (D) and prevent the leakage of high-pressure air through the box to the low-pressure region on top of the wing. For maximum effectiveness, the spoilers, when fully open, should have a slot below each blade, as shown at (E). In a model, the blades and boxes should be of some stable material, such as carbon-fiber-faced balsa. On a humid day, plain wood will jam solid because of expansion.

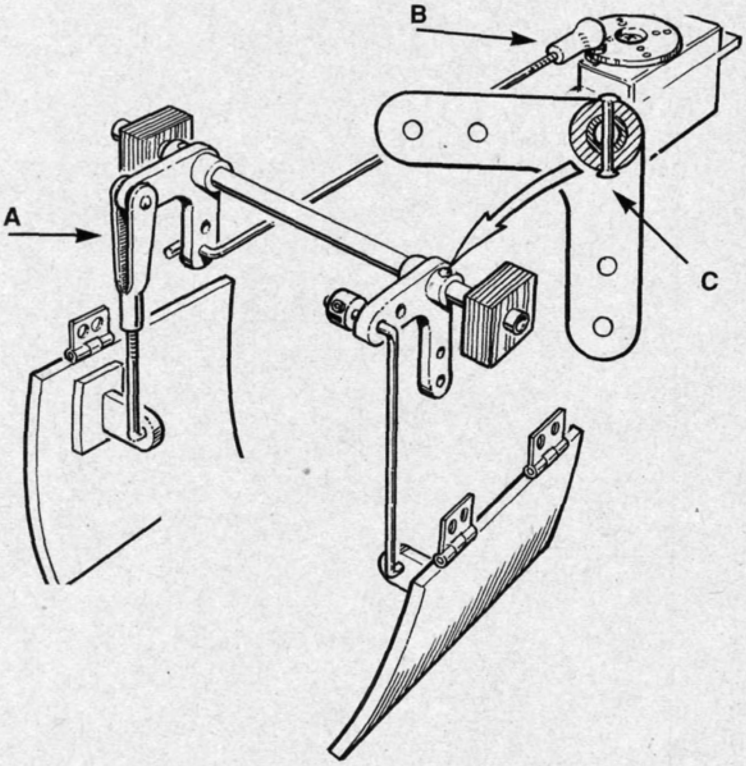
landing gear



■ **Figure 9.** On a P-51, when the pilot selects "gear down," the wheel doors open first, the gear is lowered, and the wheel doors close again. If you use air-operated gears/gear, you can buy some sophisticated, but expensive, valves to cycle the wheel doors. This effective, purely mechanical system was used successfully by Hank Pohlmann back in the mid-'70s. The system is driven by a pushrod (A) that pivots on each gear leg. As the wheel enters the wheel well, the tire (dashed line) pushes up on the pedal bar (B), thus pulling the wheel door behind it. The bend in the rod (C) allows some spring in the system.

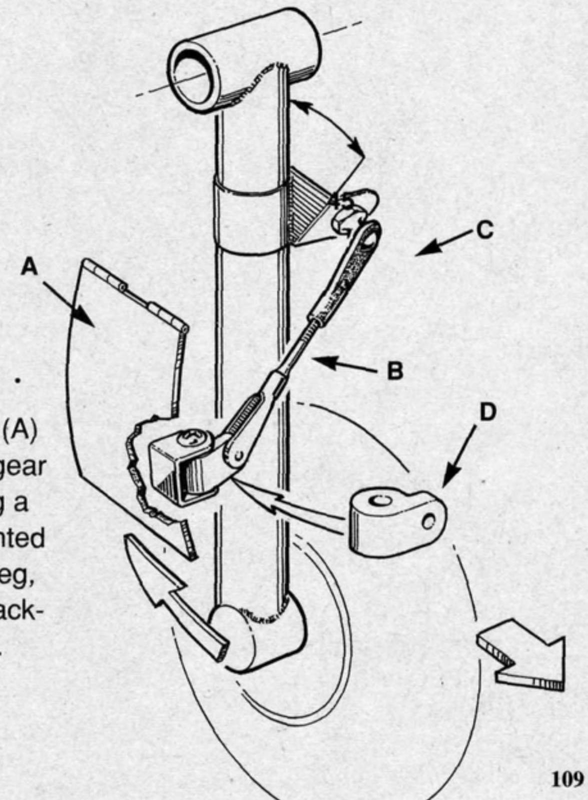


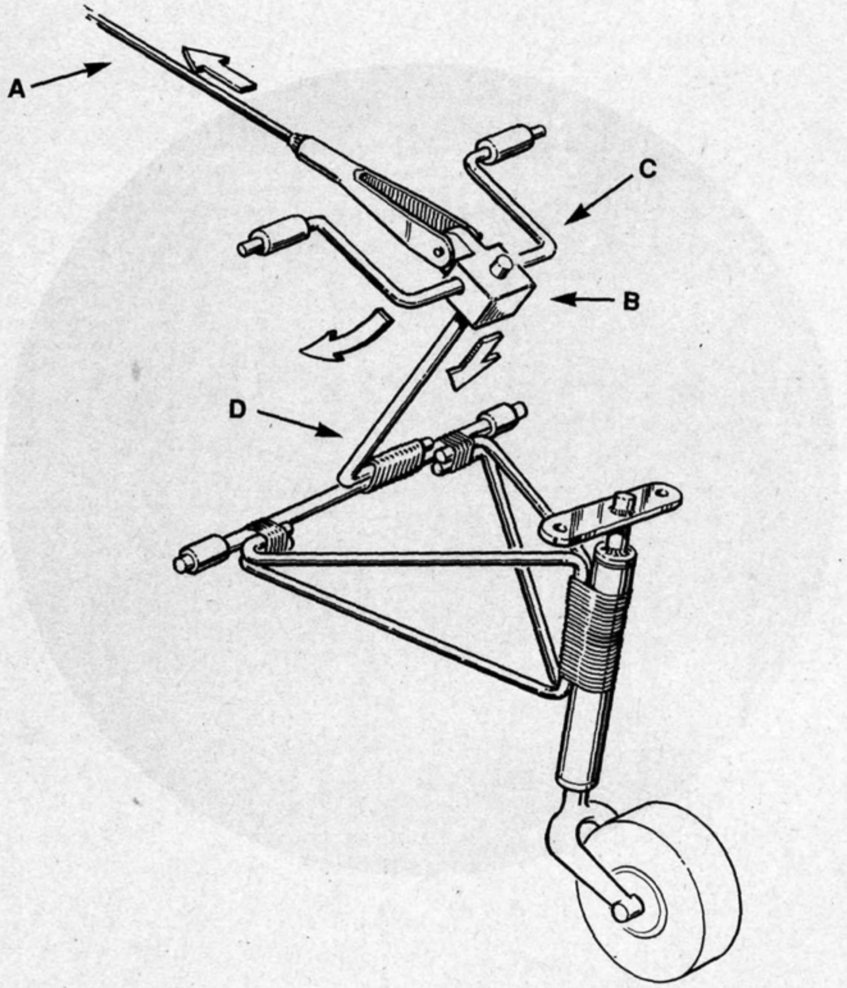
■ **Figure 10.** This wiring schematic was concocted by Britain's Dr. John Evans and was used to open and close the gear doors on a scale Corsair. On that aircraft, when the landing gear extends, the doors open, and they stay open until the legs retract. Closing the door is often done by a tricky system of wire "whiskers" or rubber bands, and this often goes out of adjustment—with disastrous results to the doors. The system shown uses an additional servo, but does not require an additional channel. Since the servo is only closing doors, the very smallest type will work well.



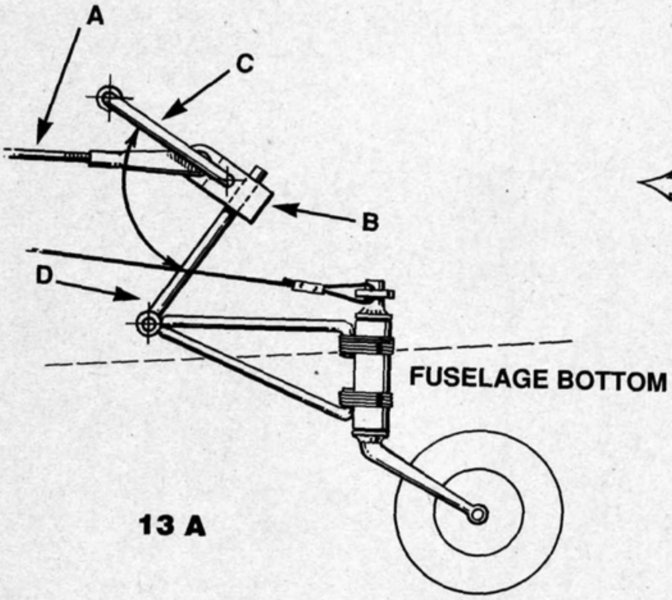
■ **Figure 11.** Well-known scale competitor Hal Parenti dreamed up this system of closing the main gear doors on his Wing Mfg. B-25. Again, each nacelle uses the smallest of servos wired in parallel through a Y-harness. The circuit shown in Figure 10 would work nicely with this setup. Two points to note: only one door has a clevis adjustment (A), because the other door is adjusted first at the servo (B); and the two bellcranks are pinned or riveted through the cross shaft with pins or brass brads (C) and then CA'd.

■ **Figure 12.** The B-25 also has a small door (A) that encloses the opening in the cowl for the gear leg. This is how Hal closed that door by taking a small link (B) off the leg. The ball joint is mounted on a sheet-metal bracket (C) soldered to the leg, while the universal joint comprises a metal bracket, a nylon aileron horn fitting (D) and a clevis.

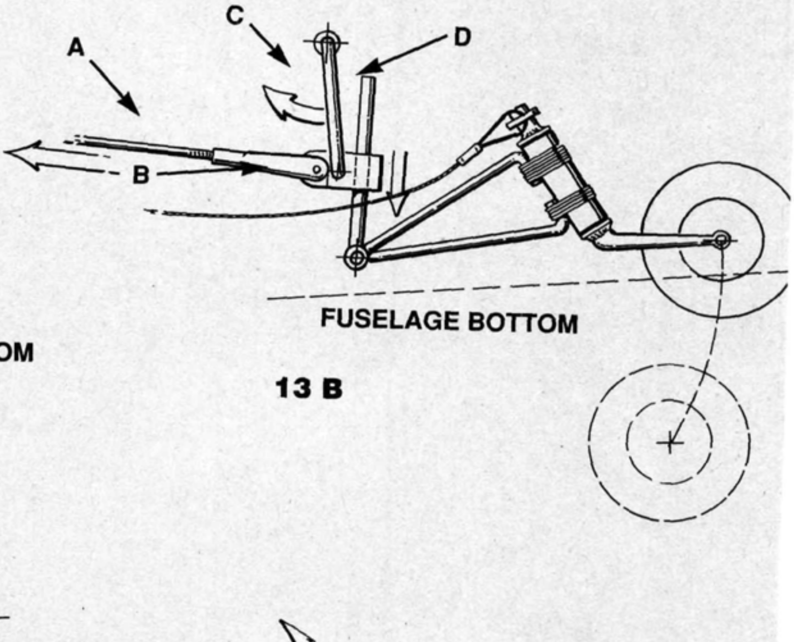




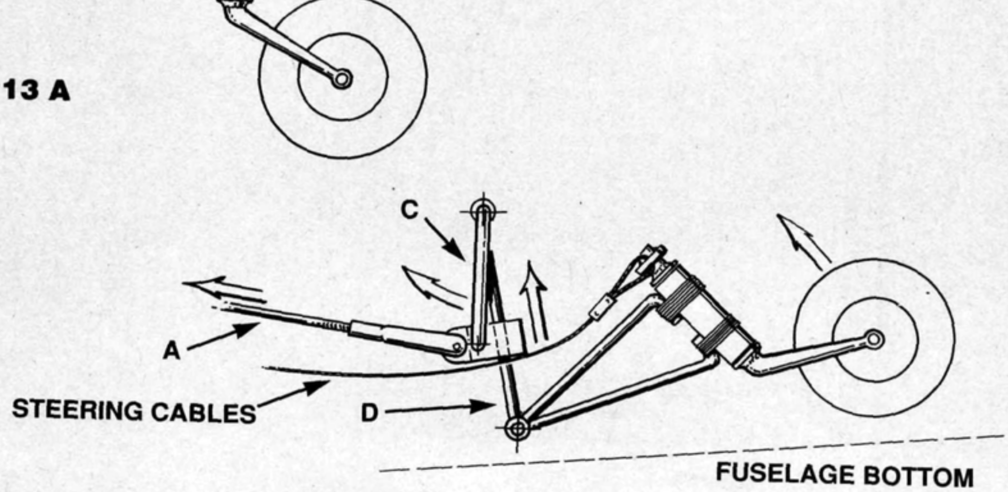
■ **Figure 13.** During the mid-'70s, Bob Carlson campaigned a beautiful Corsair complete with home-built retracting tail wheel, and this shows how he built it using bent music wire. As the rod (A) pulls on the nylon block (B), it causes the crank (C) to swing forward, at the same time sliding down the rod (D) therefore rotating the rear into the "up" position. Follow Figure 13 A, B and C for the sequence. The secret to the down-lock is the 90-degree angle between the crank and the rod.



13 A



13 B



13 C

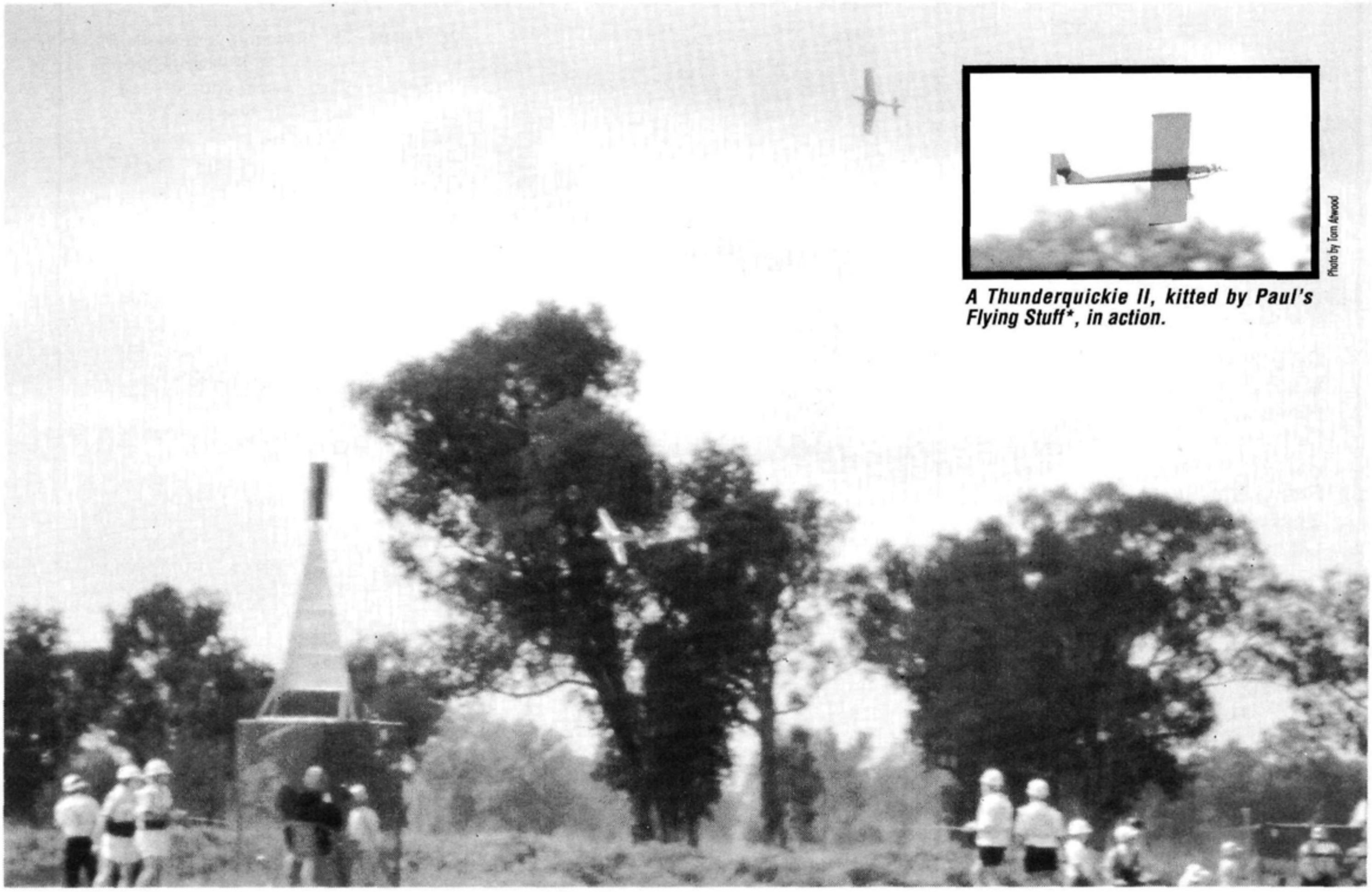


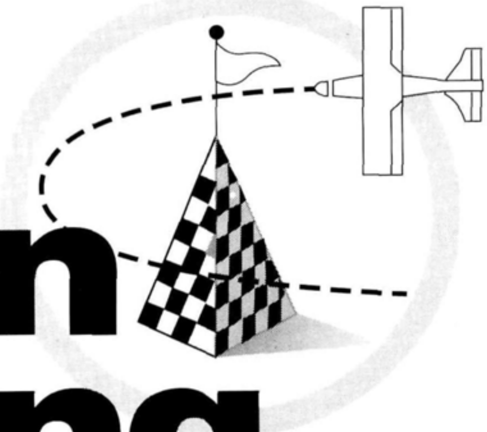
Photo by Tom Atwood

A Thunderquickie II, kitted by Paul's Flying Stuff, in action.*

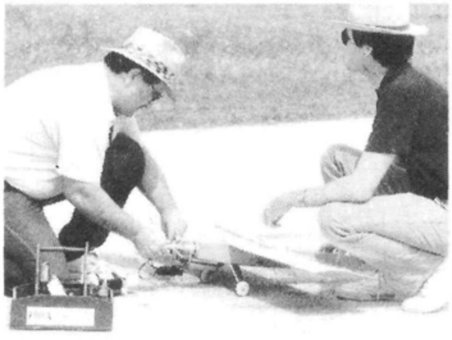
Pylon racing at the 1991 F3A world championships in Wangaratta, Australia.

Some helpful suggestions for fun club racing

LET'S GO Pylon Racing



by DAVE SHADEL

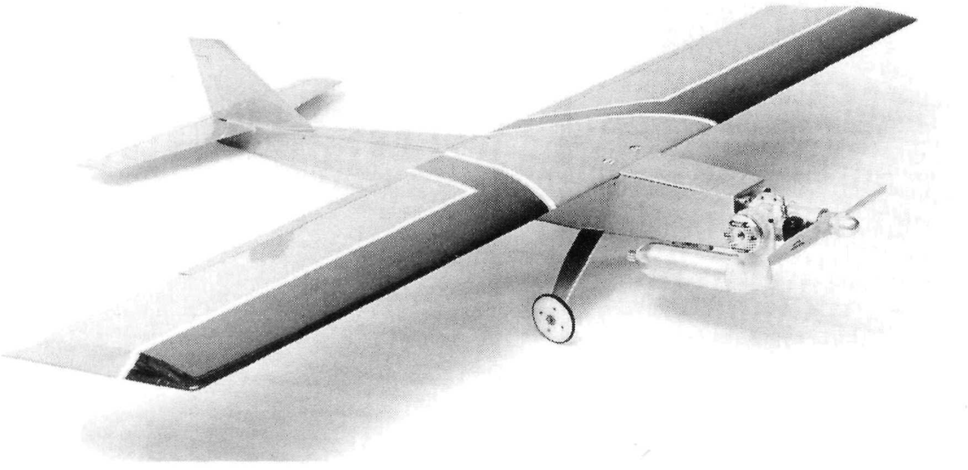


Photos by Dave Shadel

Here, a racer prepares for the start of a heat race and watches the clock until the flag drops.

YOU ASSUME A PRECARIOUS position behind four screaming engines as you await the green flag. Your knees quiver, your pacemaker is set to maximum overdrive. *This is pylon racing*.

Well, maybe it isn't quite that intense, but it can definitely make your adrenaline pump; that's the reason for this article. A lot of R/C enthusiasts participate in various levels of pylon racing, and still more would *like* to participate, but they need a push in the right direction. This article will help get your group started right at ground zero. Interested? Read on.



This new entry in the Q500 wars—the Blackjack by Steve Grattan Enterprises—can be purchased in kit orm or in various stages of completion.*

›ff the aircraft at the current market price, or hey exchange it for a new, still-in-the-box ngine of exactly the same type. If a competi-or refuses to surrender his engine in xchange for cash or a like engine, you sim-ly disqualify him from the event. Your club vould have to decide whether to entertain his type of rule.

Most races allow time to start and adjust the ngines, and to get into position. A balky ngine or a dead glow plug can, once again, esult in a zero score and ruin your chance for ictory. Have you ever noticed that some liers never have engine problems and some ave nothing *but* problems? Endeavor, hrough practice, to be a part of the first roup. Make a checklist that details the exact rder of what you need to do between heats o help avoid oversights and errors. Developing a routine will greatly improve our consistency.

PROPELLERS

'ou may choose to allow competitors to use ny prop they like, or you can mandate a rop of a given size and brand. The contest ianagers can also supply these props, which iust be returned after every heat or, if bro-en, paid for by the contestant.

FUEL

you can trust everyone in your group, set a tro limit of 10 or 15 percent and let all the iers supply their own fuel. If you think omeone might be less than honest, supply e fuel for your contest, and make sure that veryone uses it. This way, no one can use 'unny" fuel.

THE RADIO

ıst about any commercial radio can be used; ere's a good chance that most of the radios at are currently being used at your flying te are suitable. Radios used for pylon racing must have superior adjacent channel and 3IM characteristics, i.e., the capability to resist interference, because the pilots will stand close to one another while they're racing. The current popular radio for most high-level racing contestants is Futaba's* 5 UAF/UAP or 7 UAF/UAP with high-performance servos such as the Futaba S-3002. In addition to their superior electronics, these radios with-stand the punishment of all-out racing extremely well. At any level of racing, you'll get the best results with equipment that's reli-able and interference-free. Servos that center with extreme accuracy are also helpful, espe-cially in high-performance aircraft.

SETTING UP A RACECOURSE

Many flying fields don't have enough room for an AMA course, which specifies safety distances from the course to spectators and to the pit areas. If you *can* set up this type of course, however, your fliers will be accus-tomed to a regulation course if they decide to race in an AMA-sanctioned contest. An AMA course must provide worker protection, i.e., cages or airplane-proof barriers at each pylon and at the starting line.

The accompanying drawing shows an alternative and more easily workable course that can be used at virtually any flying site, if you aren't able to set up an AMA course.

OPERATION OF A HEAT RACE

Establish a matrix so that frequencies are mixed correctly and everyone gets to race with everyone else. The NMPRA* uses a matrix that drops every third frequency to prevent interference.

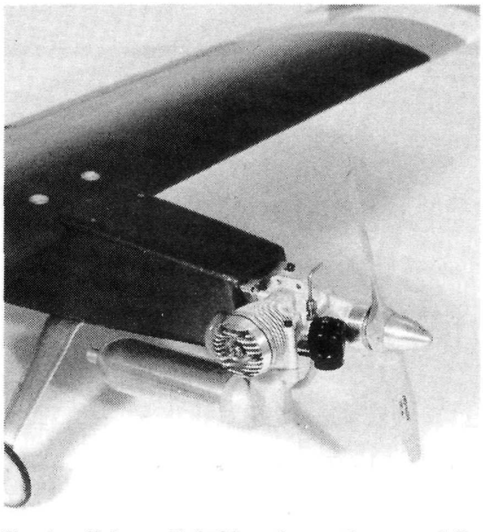
You'll need course "workers" as detailed on the drawing. So that all the contestants have enough time to service their aircraft between heats, try to avoid using pilots to work the course.

Race either three or four planes in each heat. In a four-aircraft-per-heat matrix, first place is awarded four points; second, three points; third, two points; and fourth, one point. There's an automatic one-point penalty for one pylon cut, and an automatic zero score for two pylon cuts. In a three-aircraft matrix, award three points for first place, etc. The penalties for pylon cuts are the same. Remember that you can't mix three- and four-plane matrixes.

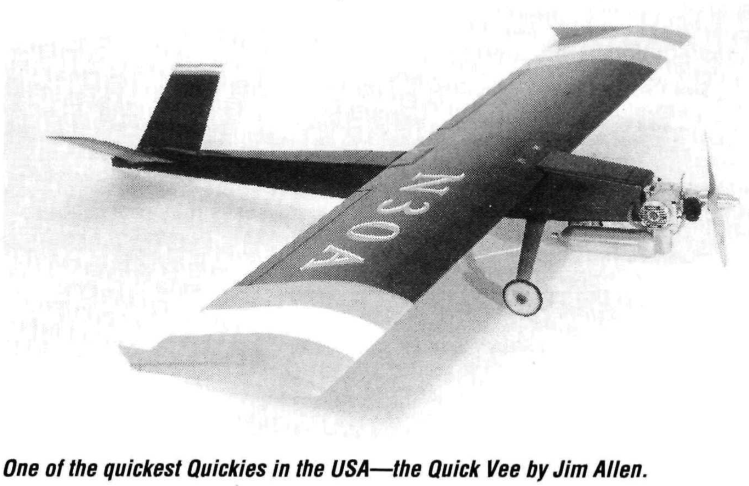
Look at the pilot stations and aircraft launching positions in the course drawing. Make sure that there's enough space (about 10 feet) between the planes to prevent colli-sions on takeoff.

The starter will typically allow 60 to 90 seconds for the contestants to start and adjust their engines. In the modified course, you can

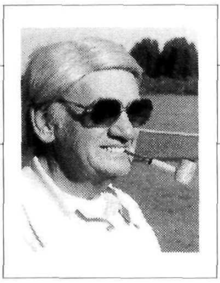
(Continued on page 148)



Here's a Nelson .40 Q500 engine on the nose of Jim Allen's Quick Vee. Note the clean installation.*



One of the quickest Quickies in the USA—the Quick Vee by Jim Allen.



HAL DeBOLT

FAREWELL TO A FRIEND

HERE WE GO again; it's sad, but inevitable. Suffice it to say that no other group will have the privilege of living and participating in modeling from its conception to today's pinnacle. When most of us first flew, the only power available was rubber, and the model had to be free-flight. This generation has seen it all, and just look at us now!

Ed Izzo and his magnificent Spirit, which was donated to the Smithsonian.

This time, I'm sorry to report the unexpected passing of my lifelong friend and fellow modeler Ed Izzo of Winter Haven, FL. He was one of those who saw it all, so to speak. For most of his 71 years, he was a resident of the Syracuse, NY, area, and he spent a short time in New England.

Those who knew Ed also knew his wife, Louise, who was his "right hand" and constant companion. To know Ed was to know Louise; they were like two peas in a pod. Without her, Ed couldn't have accomplished all that he did. Of course, we all offer her our heartfelt sympathy. She reports receiving hundreds of letters, cards, etc., plus phone calls and visits, and she expresses her thanks and appreciation for everyone's thoughtfulness.

Ed was a research engineer for a major corporation, and besides his work, modeling was his life. Very knowledgeable, he tended to be outspoken about whatever leading edge he was on at the time. He was a gentle, generous and gregarious person who will be sorely missed!

My friendship with him began in western New York state, where several of us became the ringleaders of the area's modeling. This motley crew included Ed Keck, Don Steeb, Larry Jenno, Howard Dart and Jim Hansen. We were competition-oriented from free-flight days through control-line and on into R/C. Ed's competitive endeavors were more noteworthy when we got into R/C. Above all else, Ed was always a master modeler/craftsman; his meticulous workmanship ranked with the world's best. Have you heard of the fin-

NORTHERN STAR

Some have said I've been remiss by not discussing early Canadian R/C efforts. I *have* wanted to, but lack of details is always a hindrance. Can someone add to this report? Appreciated!

I suspect that Canadian R/C started about the time it did across the border in Buffalo, NY; much migrated north.

Certainly, one of their leaders was Warren Hitchcox of Oakville, Ontario. Warren was another fine modeler who left us all too soon. He was a classic gentleman, an excellent modeler/flier and a prime mover in Canadian model aviation. At an early time, I delivered a C-S 465 system and a LW Trainer kit to Warren, putting him into R/C. He progressed rapidly with us, reaching a competitive level quickly. Warren and his lovely wife, Shirley, became fixtures at major U.S. R/C events. They carried the message home to Canada, inspiring others to follow. Along the way, Warren developed his own version of what a pattern craft should be, continuously refined it, and aptly named it, "Canadian Sunset." He represented his country well on their FAI championship team. To say that Warren Hitchcox was a major cog in the Canadian R/C wheel would be putting it mildly!

Canadian Ron Chapman proudly displays his Norseman pattern entry—one of a succession of design developments.

Even closer to me is Ron Chapman, a true Canadian R/C pioneer of Toronto, Ontario. Like many in those days, Ron assembled the "latest" radios and models, broke them, and tried again with everlasting hope. Persistence pays, and it wasn't long before Ron began to see the results of his efforts.

Ron spent his life as an industrial arts instructor in Toronto schools—great for a modeler; summers off! Retired for a number of years, he fills his time with various aspects of modeling.

Somehow, Ron and I got together (as diehard modelers will!) and, for a number of years, we traveled the country far

Lifelong friends Hal and Ed at a recent Northrop model show.

ish on which a fly couldn't find a footing? Ed's efforts would blind any fly that got close to it! His craftsmanship prevailed with his competition craft. Although some of the crew, for lack of time, might show up with something a bit "ratty," Ed was never seen with anything but his best effort!

Ed's light brightened even more when he got into pattern. For the most part, the crew persisted in designing, building and flying their own versions of what a pattern entry should be. Ed was always at the forefront. More often than not, a western New York competition would find Ed Izzo, Ed Keck and me duking it out. In pattern, Ed's enthusiasm took him beyond the area to most of the major competitions in the country, including the Nats. Ed was always a force to contend with. At a major meet our "crew" would often have a competition within the contest. Ed would be exuberant when he could out-duel the rest of us.

AND ED INVENTED...

Is there anyone who isn't familiar with foam-core wings these days? Would you believe that Ed Izzo invented them? In the course of Ed's work, there was a need to investigate "hot wire" foam cutting, and it proved to be practical. His modeler instinct suggested that the method could be used to produce model wings. In short, he developed the cutting method and needed structure. Ed demonstrated this at model shows, etc., that year, and the ball rolled from there.

After he retired, Ed switched to giant scale, which is predominant in the Orlando area. Then, with the recent Lindbergh anniversary, he felt it fitting to replicate the "Spirit of St. Louis," right down to powering it with a 9-cylinder radial engine. When I kidded him

Inseparable Ed and Louise with Ed's giant-scale Focke Wulf at Mile Square in California.

about the lack of shine in the finish, he said, "Darn you; that's the real plane's finish right down to the brand of dope!" We did have good laughs!

As it might be with a great modeler, two days before he passed away, Ed and Louise had completed and checked out a new, giant-scale, Sopwith Pup. The plan was for them to test-fly it the next day, but, obviously, it wasn't meant to be.

Ed Izzo: fellow modeler, a master of the art and one of my lifelong friends. God bless him. ■

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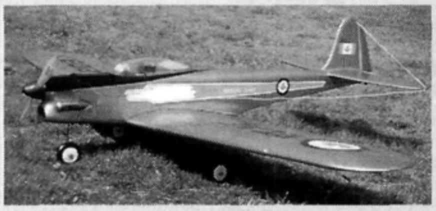
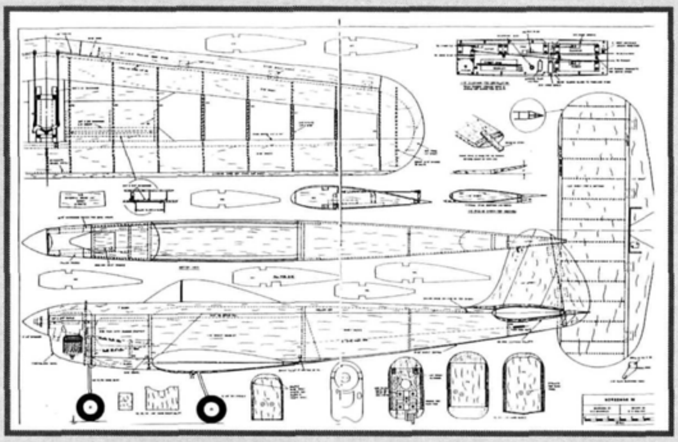
and wide, following the contest circuit. We sure had our ups and downs! An anecdote of a disastrous Dallas Nats is a downer. On my first flight with my best Interceptor, the engine went lean and overheated. That plus the excessive Dallas heat melted the plastic housing on the retract gear motor, causing the gear to hang up; this drained the battery. Then the radio quit, resulting in a short Nats for me. The Canadians fly off grass fields, and Ron had found "springy" landing gears to be an advantage on them. This Navy base, however, had concrete runways. Ron made up for my shortcomings with excellent flights until the landings. Those springy gears catapulted his Golden Hawk off the concrete on every landing! We both wound up with zilch that time around!



Ron Chapman's Golden Hawk was the pinnacle of his pattern designs. It was done in the colorful paint scheme of the RCAF aerobatic team.

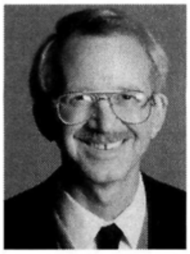


The Norseman plans reflect a modern approach in the early '60s.

Ron was an acknowledged Canadian leader for many years and a member of their FAI championship team several times.

How about it, Canucks; do any of you have more to tell us about?

ELECTRICS



MITCH POLING

EVALUATING YOUR MOTOR
PART 2

IN PART 1 of "Evaluating Your Motor" (*Model Airplane News* "Electrics" column, November '94), I explained the motor equations that were used in the February '94 column and how to use them to test your motor's performance. In Part 2, I'll explain the equations and show you how to use this information to match motor to model and choose the right prop.

RESISTANCE LOSS

The equations in Part 1 assume that the motor is "lossless," i.e., it needs no energy to turn itself. I stated in the February column that this is good enough for most hobby motors except near zero current. Several readers wrote in to say that the lossless assumption isn't good enough for many of the situations in which we use our motors and that I should explain the situation a little more. I agree, especially because I fly duration electrics, and the "lossless" assumption isn't adequate for describing the motor at the low currents I use (1 to 2 amps).

Motors need energy to overcome drag caused by bearing friction, brush friction, air resistance and residual magnetic fields. This drag is called "resistance loss" (RL), and it is approximated by the value of the no-load voltage (Vo) divided by the no-load current (Io). The result equals the RL in ohms. The Vo and Io values are measured with a voltmeter and ammeter; they are not calculated values. For the WEP* motor example used in Part 1, this was 11.23 volts (Vo)/3.6 amps (Io), which equals 3.12 ohms (RL). This follows Ohm's Law: V = I x R.

"REAL" POWER OUTPUT

To calculate the "real world" power output (Po) of a motor, you must modify the Po equation [Po = A (Vt – A x Ra)] to accommodate the resistance loss. The Po equation becomes Po = Va (A – Va/RL), in which Va is the back voltage; A is operating current; and RL is resistance loss. Let's go through the "five cells at 25 amps" example used in Part 1. We already calculated Va for 25 amps and five cells to be 3.07 volts. Using the modified Po equation, we get 3.07 (25 – 3.07/3.12), which equals 74 watts. The %M, %S and rpm are calculated as shown in Part 1 using the equations in the sidebar. Compare the values when RL is taken into account with those of a lossless assumption.

	Po	%M	%S	Rpm
With loss	74	70	47	14,000
No loss	77	72	49	14,000

You can see that there isn't a lot of difference. At currents of more than 10 amps, it may not be worth the extra effort to measure the unloaded voltage and current and calculate the modified Po equation.

The situation changes drastically at lower currents. Let's run this example through with five cells at 5 amps, assuming losses of 0.012 ohm per cell and 0.02 ohm for wiring as before. Vt is then 5.85 volts, and Va is 5.61 volts. The comparison of the results is as follows:

	Po	%M	%S	Rpm
With loss	18	62	58	25,600
No loss	28	96	90	25,600

As you can see, you would be badly misled by the no-loss numbers. Wouldn't it be great to have a motor that's 96 percent efficient as predicted by the lossless equation? Note the actual situation: the 62 percent efficiency at 5 amps is worse than the efficiency at 25 amps (70 percent)! This shows that you can get into trouble operating at too low a current. This also

MOTOR EVALUATION EQUATIONS

Use two motor runs—once with a prop and one without; measure the voltage at the motor's terminals; measure amps and rpm.

RPM1 = rpm of the first run
RPM2 = rpm of the second run
A1 = amps for the first run
A2 = amps for the second run
V1 = volts for the first run
V2 = volts for the second run

Armature resistance (Ra)
Ra = (V1 – V2 x RPM1/RPM2)] / (A1 – A2 x RPM1/RPM2)

Motor speed constant (Km)
Km = 1000 x (V1– V2 x A1/A2)/ (RPM1 – RPM2 x A1/A2)

For any motor run: A = current in amps
Vt = voltage at the motor terminals
Po (lossless) = power out in watts = A[Vt – (A x Ra)]
Po (with losses) = Va[A – (Va/RL)]

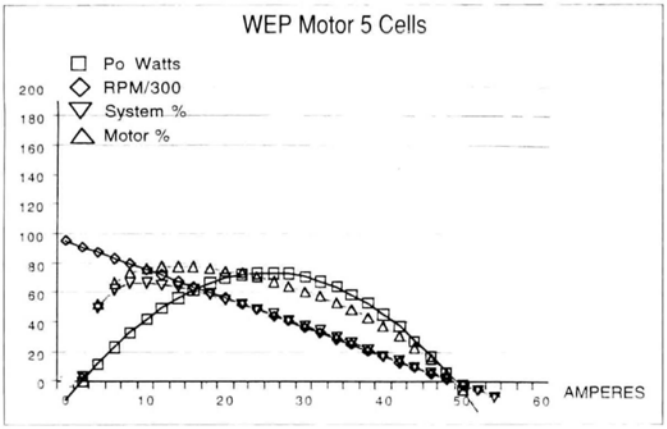
Va (back voltage) = Vt - (Ra x A)
RL (resistance loss) = Vo/Ao
Vo = measured voltage at no load
Ao = measured current at no load

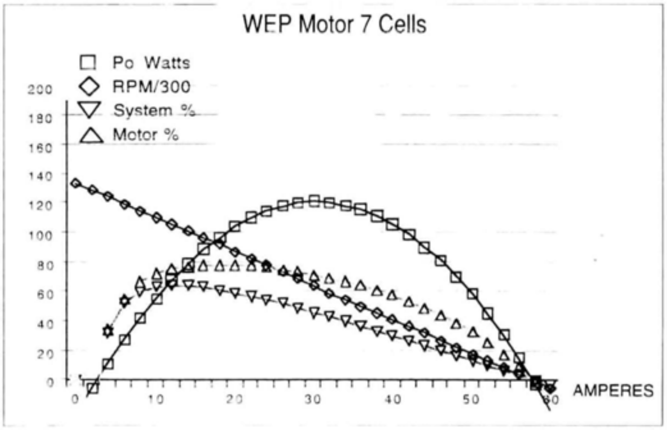
%M (motor efficiency) = (100 x Po)/(Vt x A)
%S (system efficiency) = (100 x Po)/(Vb x A)
Vb (battery voltage) = no. of cells x 1.25 volts
RPM = 1,000[(Vt - Ra x A)/Km)], or 1000(Va/Km)

The Abbott equation provides prop diameter from a given prop pitch and the Po:
$Po = P \times D^4 \times RPM^3 \times 5.33 \times 10^{-15}$

My equation for thrust in ounces is:
$Thrust = P \times D^3 \times RPM^2 \times 1.0 \times 10^{-10}$
P = pitch in inches
D = prop diameter in inches
The 1.0 is a "form factor" and can vary from 0.8 to 1.4 depending on the prop blade shape; 1.0 is an average value.

Note: in the February '94 column, I made an error in the exponent of 10.



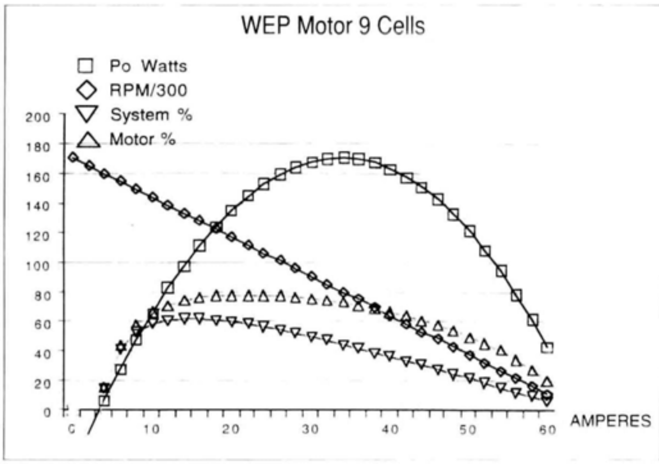


happens when too high a current is used. The graphs included with this article show this quite clearly.

CHARTING PERFORMANCE

The best way to get a complete picture of a motor's performance is to calculate the Po, %M, %S and rpm over a range of currents. I usually do this for current from 0 to 30 amps, in increments of 1 amp. Because I'm interested in finding the maximum efficiency (the lossless equations do not show an efficiency peak), I do this using the equations that take motor loss into account. Doing this requires a lot of calculating, and although I have done it by hand a few times, I soon decided to do it by computer. Ed Westwood, whom I wish to thank for educating me about motor equations and resistance loss, sent me a program in BASIC that made this easy. I've been sending this program to readers who send me $1 (to cover copying costs) and an SASE. (It's still available if you're interested; write to me at 601 Medical Squadron, PSC 10 Box 1908, APO AE 09130.)

Spreadsheets, another way to generate the information, are very handy to use. Best of all, most of them have graph routines so that you can see the results at a glance. I have a spreadsheet routine that I developed for the Macintosh using Claris Works. This is probably similar to other spreadsheets, such as Microsoft Works for IBM machines. The spreadsheet routine is available; send me $2 (to cover the copying costs) and an SASE. It isn't on disk, so you'll have to copy it from the printouts and be familiar with how to set up spreadsheets.



The graphs shown in this column were done using the Claris Works spreadsheet on a Macintosh LC. I like to graph current (amps) horizontally and the Po, %M, %S and rpm vertically. Motor manufacturers often prefer to plot torque (or rpm) horizontally, with the remaining quantities placed vertically. If you wish to plot torque, it is easily calculated: torque expressed in metric terms (Newtons x centimeters) = 0.955 x current (amps) x motor constant (Km); or torque in U.S. standard terms (ounces x inches) = 1.35 x current (amps) x motor constant (Km). The graphs look nearly the same. Current is the easiest to graph horizontally on the computer because the equations are solved by "stepping" through the current range.

Motor manufacturers usually provide graphs that go all the way from zero power out (all the energy goes to turn the motor) to zero power out (all the power goes to heat). This is what the graphs in this article show. We're not interested in the graph once the power peak is passed, however, unless we want to use the motor as a heater! I usually make my graphs up to show the

(Continued on page 149)

A gearbox allows the use of a larger diameter prop. When you match your motor to a prop, the gearbox reduction must be taken into account.

HOW TO Understanding Airfoils

Basic information for successful wing design

by Andy Lennon

Author's note: this continues "Airfoil Selection," which was published in the May and June 1992 issues. It's suggested that you read the first two articles again.

THE SELECTION OF an airfoil section for most powered models is considered not to be critical by many modelers and kit designers. Models fly reasonably well with any old airfoil, and their high drag is beneficial in steepening the glide for easier landings. Some years ago, there was a rumor that a well-known and respected Eastern model designer developed his airfoils with the aid of the soles of his size 12 Florsheim shoes.

In contrast, the R/C soaring fraternity is very conscious of the need for efficient airfoils. Their models have only one power source: gravity. The better the airfoil, the flatter the glide and the longer the glider may stay aloft.

This article is intended to provide readers with a practical, easy understanding of airfoil characteristics so that their selection will suit the type of performance they hope to achieve from their designs. It does *not* go into detail on such subjects as laminar or turbulent flows, turbulators, separation and separation bubbles, etc. (These are fully described in references 13 and 14 in the "NACA and NASA Data" sidebar.)

REYNOLDS NUMBERS

A most important consideration in airfoil selection is "scale effect." The measure of scale effect is the Reynolds number (Rn). Its formula is:

Rn = Chord (in inches) x speed (in mph) x 780 (at sea level).

A full-scale airplane flying at 200mph with a wing chord of 5 feet (60 inches) is operating at Rn 9,360,000. A scale model flying at 60mph with a wing chord of 10 inches flies at Rn 468,000. When landing at 25mph, the model's Rn is reduced to 195,000.

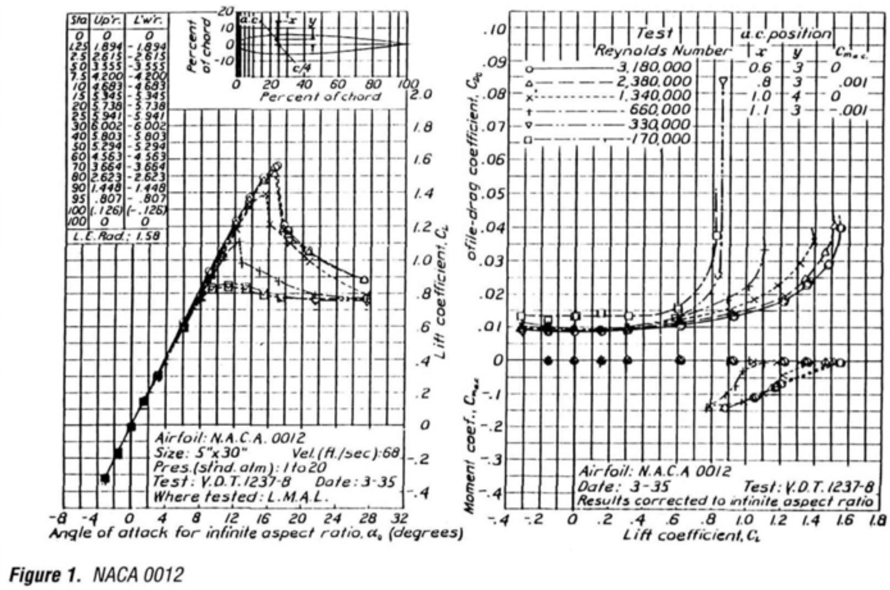


Figure 1. NACA 0012

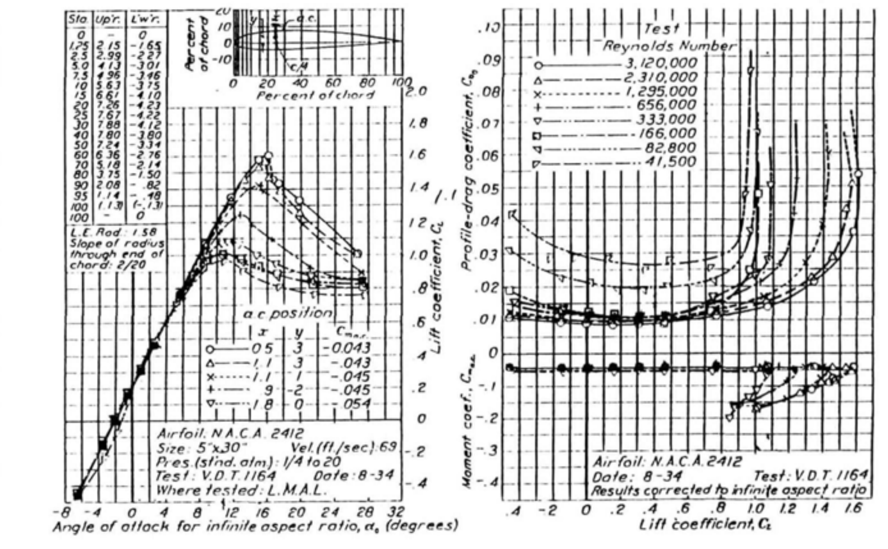
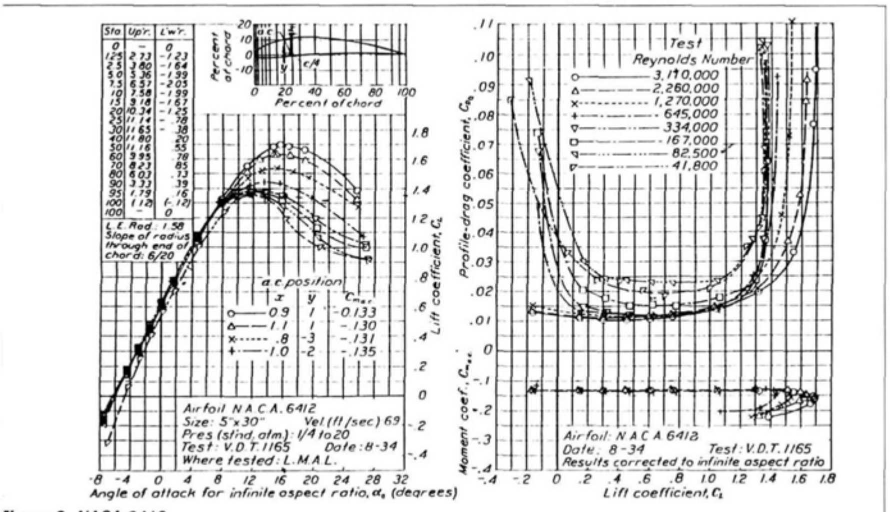


Figure 2. NACA 2412

In 1937, NACA issued Report No. 586 (see sidebar), which shows the shocking adverse impact of scale on airfoil characteristics (based on tests in a variable-density wind tunnel over a wide range of Reynolds numbers, as shown in Figures and 2). Note that the Rns shown are "tes results and require correction for a "turb lence factor" that wasn't recognized durii the tests. This factor is 2.64. Each Rn



igure 3. NACA 6412

gures 1 and 2 should be increased by this ctor.

The airfoils involved in these figures e "related sections." NACA 0012 is sym-etrical; NACA 2412 was developed by /rapping" the symmetrical section around cambered mean line so that the upper and wer surfaces were equidistant from the mber line. For NACA 2412, this mean ie has a camber height of 2 percent of the ord length, with its highest point at 40 rcent.

NACA 0012 in Figure 1 shows a shock-g reduction in maximum lift coefficient om 1.55 for the highest Rn to 0.83 for the west—a difference of 54 percent of the gher value.

Similarly, the stall angle of attack is arply reduced from 17 degrees for the ghest Rn to 10 degrees for the lowest. ne very interesting phenomenon is this rfoil's behavior beyond the stall at the wer Rns. It continues to lift up to 28 grees at almost full value.

Profile drag at low Rn is almost double at at high Rn and increases very signifi-ntly at the stall and beyond—not surpris-g, considering the post-stall lift behavior.

NACA 0012 has a zero pitching oment, except beyond the stall where it's gative (nose down) and stabilizing.

NACA 2412 in Figure 2 is a popular ort-model airfoil. Compared with NACA 012, the maximum lift coefficient is ghtly higher at 1.6 at the highest Rn. At e lowest Rn, with the turbulence factor counted for (41.500 x 2.64, which equals 9,560), the C_L max drops to 0.95, or 59 rcent of that of the highest Rn. The stall gle is reduced from 16 degrees to 11 grees. Both lift and stall angles are gher than for NACA 0012.

Profile drag increases almost threefold the lowest Rn. Owing to this airfoil's mbered mean line, the pitching moment minus 0.06.

For NACA 6412 in Figure 3, the CL max goes from 1.7 to 1.35 (79 percent). The stall angle reduces from 16 degrees to 12 degrees. Profile drag doubles at the lowest Rn.

It should be noted, however, that camber increase obviously improves CL max and stall angle for this relativly thin (12 percent) section at low Rns.

The pitching moment, due to its higher camber, is 0.135 negative. A horizontal tail would need to produce a heavy down-load to offset this pitching moment, resulting in an increased "trim drag."

In 1945, NACA issued Report No. 824, "Summary of Airfoil Data" (sidebar reference no. 5); it includes data on their "six-number" laminar-flow airfoils. NACA 64_1-412 is typical (see Figure 4). The lowest Rn is 3,000,000.

These airfoils were developed similarly to those in NACA Report No. 460 (sidebar reference no. 1): a symmetrical section wrapped around a cambered mean line. However, careful study of pressure distribution allowed this type of airfoil to obtain a very low profile drag (over a limited range of lower lift coefficients). The P-51 Mustang WW II fighter employed airfoils of this type. The "low drag bucket" at C_L 0.4 shown in Figure 4 shows this drag reduction.

In 1949, NACA issued technical note 1945 (sidebar reference no. 6). This compared 15 NACA airfoil sections at Rns from 9,000,000 (9×10^6) to 700,000 (0.7×10^6).

The C_L max of NACA 64_1-412 at Rn 9×10^6 is 1.67, but it drops to 1.18 (70 percent of the highest Rn) at Rn 0.7×10^6. Profile drag increases from 0.0045 to 0.0072 for the same Rn range, and the stall angle is 16 degrees, but it drops to 12 degrees at the low Rn. Pitching-moment coefficient is 0.063.

This report concluded that at *low Rns*, the laminar-flow section did not offer substantial advantages over those in report no. 460 (sidebar reference no. 1) and report no. 610 (sidebar reference no. 3). NASA (NACA's successor) continued to do research into laminar-flow airfoils with much success; but at the high Rns of full-scale airfoils and aided by computer analysis. (sidebar references 7, 8 and 9).

The worldwide R/C soaring fraternity, however, has done much wind-tunnel testing and computer design of airfoils for model gliders (sidebar references 10 to 15 inclusive). Though the Rn range of these tests seldom exceeds Rn 300,000, any airfoil that offers good performance at this

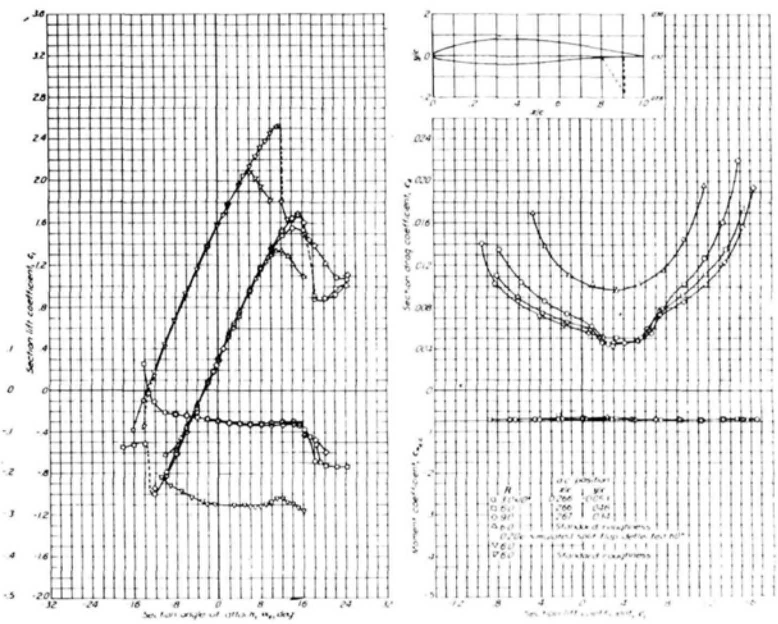


***Figure 4.** Aerodynamic characteristics of the NACA 64_1-412 airfoil section, 24-in. chord*

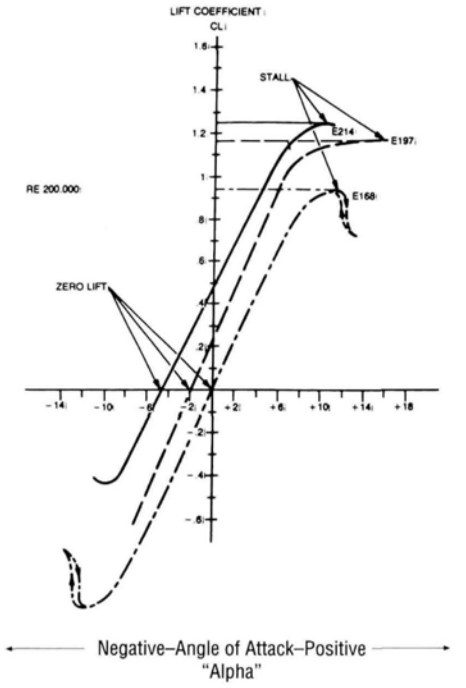


Figure 5. *Lift curves of three airfoil types*

low Rn can only improve at the higher Rns of powered flight. A 10-inch-chord at 100mph is operating at Rn 780,000.

The selection of an airfoil for a design should start with a review of airfoil plots of the type in this article. In this author's experience, the plots of the University of Stuttgart published by Dieter Althaus are the clearest and most comprehensive (sidebar references no. 10 and 11). The airfoils developed by Dr. Richard Eppler are favored.

MEAN LINE CAMBER

Figure 5 compares three Eppler airfoils: E168 symmetrical, E197 moderately cambered and E214 heavily cambered. The symmetrical airfoil has the lowest C_L max and stall angle. An airfoil with increased camber produces a higher maximum lift coefficient, but it starts to lift at higher *negative* angles of attack with a broader range of lift before stalling. Increased camber, however, produces increased pitching moments.

Out of curiosity, the camber mean line for the E197 airfoil was straightened out and the envelope was re-drawn as in Figure 6. The result was a symmetrical airfoil resembling the E168.

Some cambered airfoils have a lower surface trailing-edge "cusp" created by a localized and increased curvature in the camber mean line, as in the E214, Figure 7. The cusp increases both CL max and pitching moment; its called "aft loading." E197 in Figure 7 has a slight cusp; airfoils E207 and E209 are similar to E197, but they lack the trailing-edge cusp (sidebar reference no. 12). Airfoil E230 in Figure 7 has an upwardly reflexed camber mean line near its trailing edge. This produces a positive (nose-up) pitching moment. This airfoil would be suitable for a tailless or Delta-wing model. Inevitably, C_L Max is adversely affected.

THICKNESS

Thicker wings permit strong but light construction. They may also exact a small penalty in drag increase. Tapered wings with thick root airfoils that taper to thinner, but related, tip airfoils, are strong, light and efficient. Laying out the intervening airfoils between root and tip calls for much calculation—or computer assistance.

For high speed, an airfoil such as E226 shown in Figure 7 is suggested. Drag and pitching moments are low, as is the C_L max, and the airfoil performs almost as well inverted as it does upright. E374 i Figure 7 would also be a good high-spee airfoil section.

The author has had success with tl E197 shown in Figure 7 for sport models. has low profile drag, good lift and a gent stall, but a fairly high pitching moment.

The E168 shown in Figure 7 is suitab for strong horizontal or vertical tail su faces, or for wings of aerobatic models. performs as well upright as it does inverte

PITCHING MOMENT

The airfoil's pitching moment is importa both structurally and aerodynamically. flight—particularly in maneuvers—tl pitching moment tries to twist the wing in leading-edge-down direction. This adds the torsional stress placed on the wii structure by the ailerons and extend flaps. High-pitching-moment airfoi require wings that are stiff in torsion, ai that favors thicker sections and full wii skins, particularly for high-aspect-rat wings.

Aerodynamically, the nose-down pitc

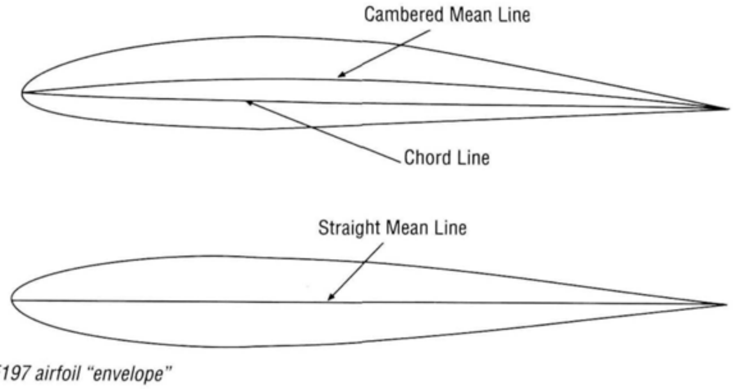


Figure 6. *E197 airfoil "envelope"*

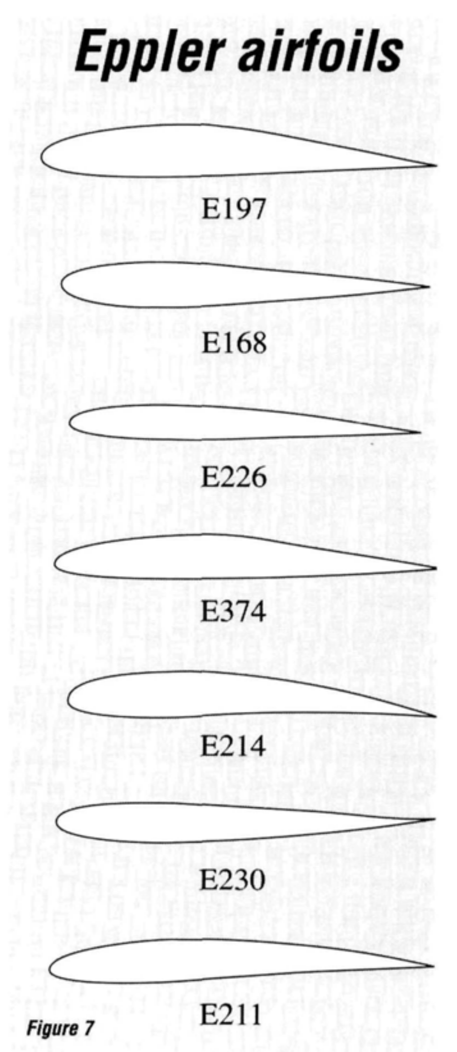


Figure 7

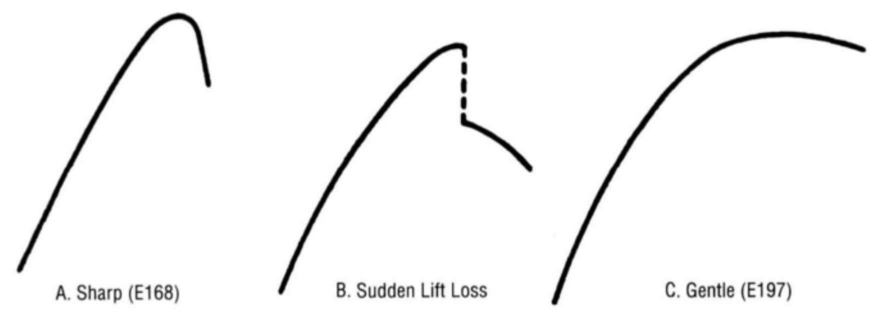


Figure 8. *Types of airfoil stalls*

ing moment requires a horizontal tail download for equilibrium. This adds to the lift the wing must produce and increases total drag—called "trim drag." The pitching moment is little affected by variations in the Rn.

STALL BEHAVIOR

One reason for preferring wind-tunnel test data over computer-developed performance curves is that the former provides an accurate "picture" of the airfoil's behavior at the stall and beyond.

In general, there are *three broad types of stall, as shown in Figure 8:*

- sharp (A);
- sudden lift drop (B);
- gentle (C).

For sport models, a type C stall is desirable. Type A or B stalls are appropriate for maneuvers in which the ability to stall a wing easily is required, such as spins.

ZERO LIFT ANGLE

The angle of zero lift for a symmetrical-section airfoil is zero degrees angle of attack. Cambered airfoil sections such as E214 shown in Figure 7 start to lift at almost 6 degrees *negative* angle of attack, *but for this airfoil*, that angle is unaffected by variations in the Reynolds number.

Contrast this with airfoil E211 shown in Figure 7. This airfoil's angle of zero lift moves closer to zero degrees at the lower Rns.

The forward wing of a canard must stall before the aft wing; but, for longitudinal stability, the aft wing must reach its airfoil's zero-lift angle before the front wing's airfoil. If the foreplane's airfoil reaches zero lift first, a violent dive results, and, because the aft wing is still lifting, a crash is almost inevitable.

The low-Rn behavior of the E211 means that, at low speeds—or narrow chords—this airfoil may reach zero lift more readily. Its use as a forward-wing airfoil on a canard is to be avoided. Airfoil E214 is more suitable.

MAXIMUM LIFT COEFFICIENT

From zero lift, higher camber results in a higher C_L max and higher stalling angles. This impacts the model's takeoff, stall and landing speeds. A high C_L max permits slower flight in all three points; a lower C_L max reverses these conditions.

SUMMARY

In aerodynamics, nothing is free. In general, high lift means increased drag and pitching moments; for high speeds, C_L max is reduced and so on. The type of performance sought for a design dictates which airfoil characteristics are significant. Having selected these, any adverse characteristics must be accepted and compensated for.

Happy flying!

**Addresses are listed alphabetically in the Index of Manufacturers on page 177.* ■

Airfoil Construction

Most powered model aircraft operate in a Reynolds number range from 200,000 to well over 1,000,000. This is above the critical range of Rns at which turbulators are considered to be effective.

For the more recently developed airfoils, there is a considerable degree of laminar flow that significantly reduces their profile drag. This flow is easily upset by protuberances on the wing's surfaces.

For smooth surfaces, full wing sheeting is suggested, with a film overlay—either over a foam-core or built-up construction—that will promote the lowest laminar flow and also result in a wing-stiff in torsion (see "Stressed Skin Design," Parts 1 and 2 in the September and October '92 issues).

There are large models whose wings have multiple spars on both top and bottom surfaces and are covered only in plastic film such as MonoKote*.

Because it shrinks on application, the film tends to flatten between each rib and each spar. As a result, multiple ridges run both chordwise and spanwise, rendering laminar flow impossible.

Contrast this with the very smooth surfaces of high-performance R/C soaring gliders.

NACA and NASA Data

1. Report 460: The characteristics of 78 Related Airfoil Sections from Tests in the Variable Density Wind Tunnel; 1933; Jacobs, Ward and Pinkerton.
2. Report 586: Airfoil Section Characteristics as Affected by Variations of the Reynolds Number; 1937; Jacobs and Sherman.
3. Report 610: Tests of Related Forward Camber Airfoils in the Variable-Density Wind Tunnel; 1937; Jacobs, Pinkerton and Greenberg.
4. Report 628: Aerodynamic Characteristics of a Large Number of Airfoils Tested in the Variable-Density Wind Tunnel; 1938; Pinkerton and Greenberg.
5. Report 824: Summary of Airfoil Data; 1945; Abbott, von Doenhoff and Stivers.
6. Technical Note 1945: Aerodynamic Characteristics of 15 NACA Airfoil Sections at Seven Reynolds Numbers from 0.7 x 106 to 9.0 x 106; 1949; Loftin and Smith.
7. Technical Note NASA TN 7428: Low-Speed Aerodynamic Characteristics of a 17 percent Thick Airfoil Designed for General Aviation Applications; 1973; McGhee, et. al.
8. NASA Technical Memorandum TMX 72697: Low Speed Aerodynamic characteristics of a 13-percent Thick Airfoil Section; 1977; McGhee, et. al.
9. NASA Technical Paper 1865: Design and Experimental Results for a Flapped Natural Laminar-Flow Airfoil for General Aviation Applications; 1981; Somers.
10. Profilpolaren für den 1900 Ellflug, Book 1; 1980; Dieter Althus.
11. Profilpolaren für den 1900 Ellflug, Book 2; 1986; Dieter Althus.
12. Eppler Profile MTB 12; 1986; Martin Hepperle.
13. Model Aircraft Aerodynamics, Second Edition; 1987; Martin Simons.
14. Airfoils at Low Speeds—Soartech 8; 1989; Selig-Donovan and Fraser.
15. Airfoil Design and Data; 1980; Dr. Richard Eppler

Sources Of Reports

1-9. U.S. Department of Commerce, National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161.

10, 11. Neckar-Verlag, Klosterring #1, 7730 Villingen-Schwenningen, Germany.

12. Verlag für Technik und Handwerk GMBH, Postfach 1128, 7570 Baden-Baden, Germany.

13. Zenith Aviation Books, P.O. Box 1, Osceola, WI 54020.

14. H.A. Stokely, publisher, 1504 N. Horseshoe Cir., Virginia Beach, VA 23451.

15. Springer Verlag, New York, NY.

GETTING INTO SCALE

(Continued from page 70)

.60 to .90 power, but 80 inches is a little too large for you, Pica has a few WW II fighters that Mr. Platt designed several years ago, including a Spitfire, a T-28 and a Focke Wulf 190D-9. Not to be outdone, Top Flite*—now owned by Hobbico*—has taken on the monumental task of redesigning several of its older warbirds to bring them up to current standards. Their Corsair was first, and now they offer the Mustang. Some of you might be able to find an older P-40, a P-39 Airacobra, a Bearcat or a Zero at a hobby shop or a swap meet; if you do, go ahead and grab it. Although they wander away from pure scale outlines, they're magnificent fliers. In fact, our old friend Dave Platt is responsible for designing the P-39 and P-40 as well (hundreds of moons ago!). All would be an excellent choice for your first contest machine.

WHAT? NO JETS!

If you've noticed that jet models are conspicuously absent from my "list," please consider that although jets are very interesting to model and fly, I strongly suggest a simple prop airplane for your first scale contest entry. If you're already an accomplished jet modeler and you just want to try scale contests, go right ahead. Some of the more well-known manufacturers that offer easy-to-build scale jet kits that fly well include Jet Hangar Hobbies*, Yellow Aircraft, Byron Originals and Bob Violett Models*.

You know, there are probably hundreds more scale kits out there that are begging to be built, and a good place to find many of them will be in the "Bonus Buyers' Guide" in the upcoming March issue of *Model Airplane News*. No, I'm not gelling you this because my column appears there. I'm telling you because it's absolutely true! The "Buyers' Guide" will have gobs of scale kits and other stuff you'll need to complete a model.

So if you can't find anything that suits your fancy in this article, look in the "Bonus Buyers' Guide."

**Addresses are listed alphabetically in the Index of Manufacturers on page 177.* ■

PYLON RACING

(Continued from page 113)

start at the pilots' stations, and t caller/mechanic can carry the running a craft to the launching position. The star raises the starting flag over his head for seconds before he drops it to start the ra At this point, all the planes are release and they accelerate toward the first pyl The lap counters count each lap as the a craft cross the start/finish line.

After each plane has completed 10 f laps, the starter flags it as it crosses the f ish line. The starter consults with the "c callers" who are next to the pylons a then determines the points that will awarded for that heat. Several heats a flown in each round; each competitor fl once in each round. When all the roun have been flown, the pilot with the m points wins. (You can fly as many roun as your group would like.) Ties are brok by a single, winner-take-all, final heat.

That should cover most of the inform tion you need to start. Now, let's go racin

**Here are the addresses of the companies and as ciations that are pertinent to this article:*

AMA (Academy of Model Aeronautics), *5151 Memorial Dr., Muncie, IN 47302.*

Nelson Competitive Engines, *121 Pebble Creek L Zelienople, PA 16063.*

NMPRA (National Miniature Pylon Raci

ociation); contact Lloyd Burnham, 715 Avery St., S. ıdsor, CT 06074.
***formance Specialties,** P.O. Box 3146, Gardnerville, 89410.*
***ve Grattan Enterprises,** 1044 Verde Way, ·denerville, NY; (702) 265-2346.*
***ı Allen's Quick Vee kits,** 956 E. Huber Mesa, AZ '03.*
***ke Del Ponte's Revolution Q500 kits;** 3637 W. ɪela Dr., Glendale, AZ 85308.*
***dger Q500 kits; available from Capstone R/C ɪply,** 562 W. Shrock Rd., Westerville, OH 43081.* ■

.ECTRICS

ntinued from page 134)

tor's performance up until just past its ver peak. This makes the graphs much ier to read.

ľo read the graphs shown in this column, k the point you're interested in on the tical axis and read horizontally over to curve for that quantity. Run a vertical down to the horizontal axis to read the rent. Take readings for the remaining ıntities by noting where their curves rsect the vertical line and reading back to vertical axis. In graph 3, if you're inter- :d in the Po of 140 watts, find that value the vertical axis, then read across hori- tally until you're on the power (Po) line, ı read down. You will see rpm of 115 x 300 = 34,500; %M = 77; %S = 60; and current = 21 amps.

PICKING A MOTOR AND A PROP

Though graphs are nice to have, a computer printout of numbers works just as well to evaluate motors. I use the number tables more often than the graphs to zero in on how I want to use a motor. I like to use a motor with an efficiency of 65 percent or more and a system efficiency of 50 percent or more.

Having made these choices, I check for power output. There are several rules of thumb for determining how much power you'll want; these rules have been formulated by Bob Boucher, Roland Boucher, Bob Kopski, Keith Shaw, me and others. I like to see a power loading of about 30 to 50 watts per pound—30 watts being on the mild side and 50 watts on the sporty-performance side. This isn't an ironclad rule—I have flown planes very much outside these limits—both above and below—but it's a good place to start. If the power looks OK, then I look at the rpm figure. If it's on the high side (above 15,000), I can adjust it by using a gearbox. Last, but not least, to get a range of prop diameters to try, I use the Abbott equation (see sidebar), Po, the output rpm (after gearing, if used) and some assumed values of prop pitch.

As an example, let's say that you have a 3-pound airplane, and you want it to perform well. When the WEP motor is run through the simulation using Ra = 0.0473, Km = 0.219, RL = 3.12, R wire = 0.02 and R cell = 0.012 for 9 cells, we get a peak power of 170 watts at 32 amps and 26,000rpm. This gives a very favorable 57 watts per pound for the plane.

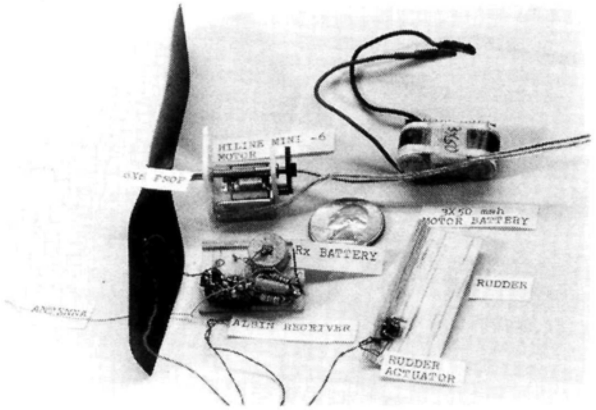
Let's choose a flying speed of about 60mph. The 26,000rpm will result in a very small prop-diameter size. A gearbox allows the use of a larger prop. I like using a 6:1 ratio because it maximizes the prop diameter. This will give a prop rpm of 26,000/6 = 4,333rpm. The pitch is then equal to: mph x 12 x 5,280/(rpm x 60) = 14.6. A pitch of 14 is close enough. Now use the Abbott equation to get the prop diameter (to do this, you will need a calculator that can take a fourth root). Using 170 watts, 4,333rpm, and pitch of 14, the diameter comes out to about 13 inches. The thrust comes out to about 57 ounces using a coefficient of 1.0 (see sidebar). This isn't a common size of prop; you may have to cut down a larger one. Or,

(Continued on page 163)

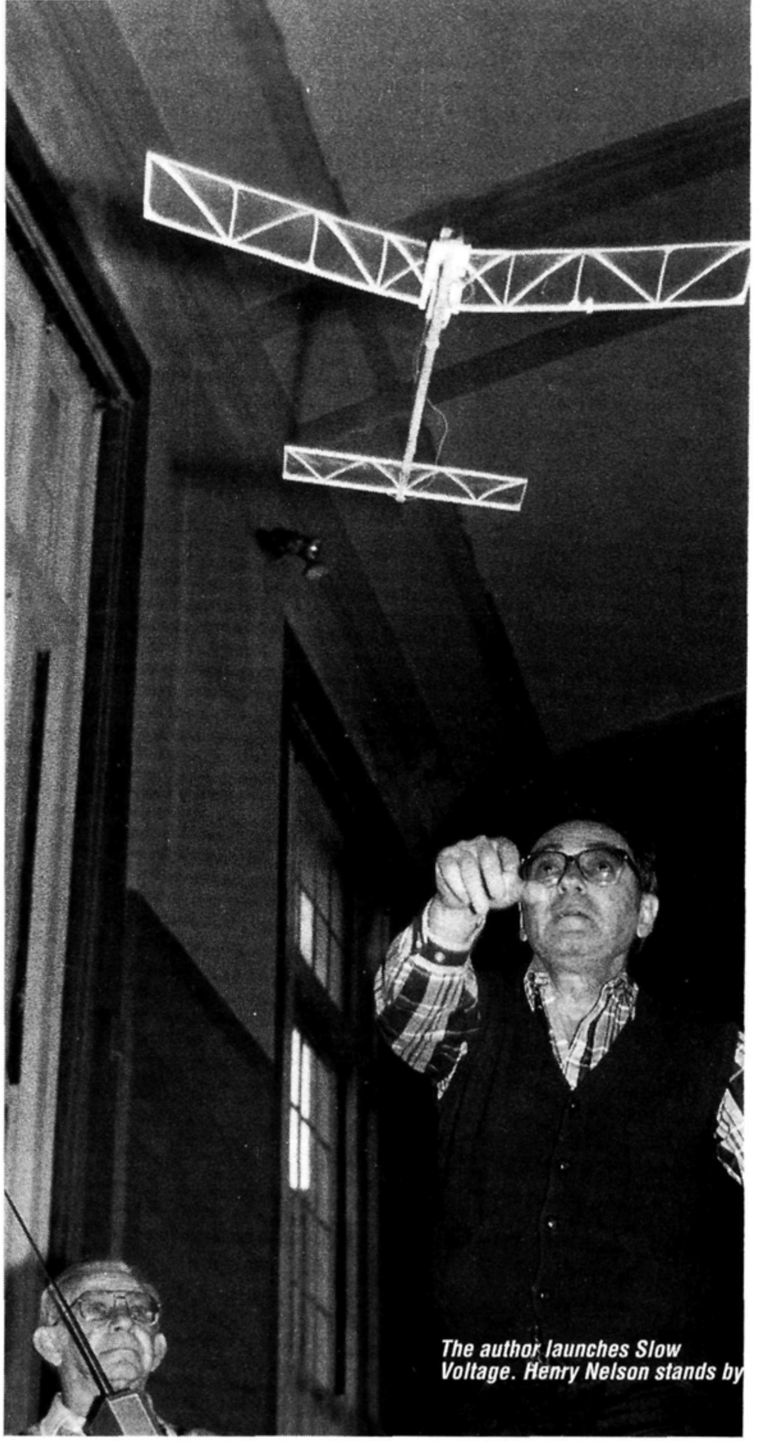
Slow Voltage

by DON ROSS

Pushing the limits of ultra-miniature, indoor R/C



The Mueller receiver, battery and actuator, the HiLine Mini-6 motor, a 3-cell 50mAh battery and a rubber-powered 6x6 prop.



The author launches Slow Voltage. Henry Nelson stands by

LIGHT, SLOW-FLYING, indoor radio-control models have been pursued by a number of modelers for th past decade. Tony Naccarato, in Southern California, and others have successfully flown indoor R/C, but the weight of these systems typically dictated larger models that required lots of space. I wanted to build a model that was light enough to control in an indoor area the size of a school basketball court. I also wanted the flight speed to be slow enough to avoid disaster every time it hit a wall.

As small, efficient motors and batteries appeared on the market, the idea began to look more promising. Then I heard that Fritz Mueller of Georgia was building a radio system that weighed only 8 grams. Based on a modernized Albin circuit and using an almost microscopic electromagnet as an actuator, the system offered on/off rudder control for right turn with spring-loaded left rudder in the off position. Fritz agreed to build a system for me and to modify an old Ace pulse transmitter that I still owned.

Now I had the basis for a practical design project. School basketball courts are about 60 to 70 feet wide, so I felt comfor able with a span of 24 inches, which would allow a decent figure 8 at the speeds I expected. A good, low-drag aspect ratio i 8:1, which gave me a chord of 3 inches and a wing area of 72 square inches. The available wing area is important becaus wing loading is much more critical in indoor models than in almost any other design category.

WING LOADING

/ing loading is the weight in grams or unces carried by each square inch or ןuare foot of wing. As wing loading ıcreases, speed goes up even faster and so ɔes turn radius. Just a few grams can trans-ɔrm a cute, slow-flying, peanut-scale ıodel into a speed terror that zips around ke a control-line airplane until it re-kits self against the wall, ceiling, or floor.

R/C sailplanes fly well with wing loadings 9 to 12 ounces per square foot, and pow-ed models have even higher loadings, but good indoor design requires a maximum about 3.8 ounces per square foot, or less an one third that of an outdoor R/C model. ɔr small models, I prefer to work in grams r square inch. (Just multiply ounces per uare foot by 0.1968 to get grams per uare inch.) Thus, I needed around 0.75 n./sq. in. x 72 sq. in. = 56 grams all-up eight, or just around 2 ounces. Larger, avier, indoor R/C models have been flown th wing loadings as low as 2.5 oz./ sq. ft. ss than 0.5 gm/sq. in.), but these have quired larger flying sites.

POWER SYSTEM AND AIRFRAME

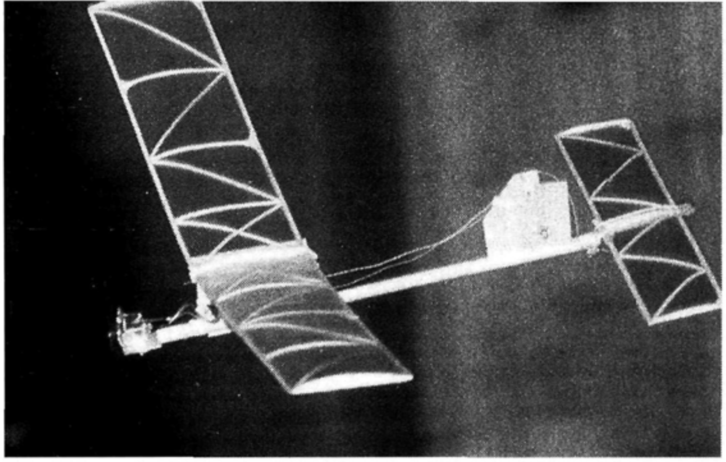
ıe HiLine* Mini-6 motor with 3-cell, ıAh battery and prop weighs 34 grams, d the VL-HY70 weighs about the same. ld 8 grams for the R/C system, and you ve only 12 grams left for the airframe. I lt I could do the job with a wing at 5 ams, a fuselage at another 5 and tail feath-s at 2. This required careful wood selec-ɔn and a no-frills design covered with mething even lighter than doped tissue.

chose a 6-inch diameter by 6-inch-pitch rubber-power prop with a wide, square blade. You old-timers may recognize it as originally made by Tern Aero and now sold by Peck Polymers* as part PA015.

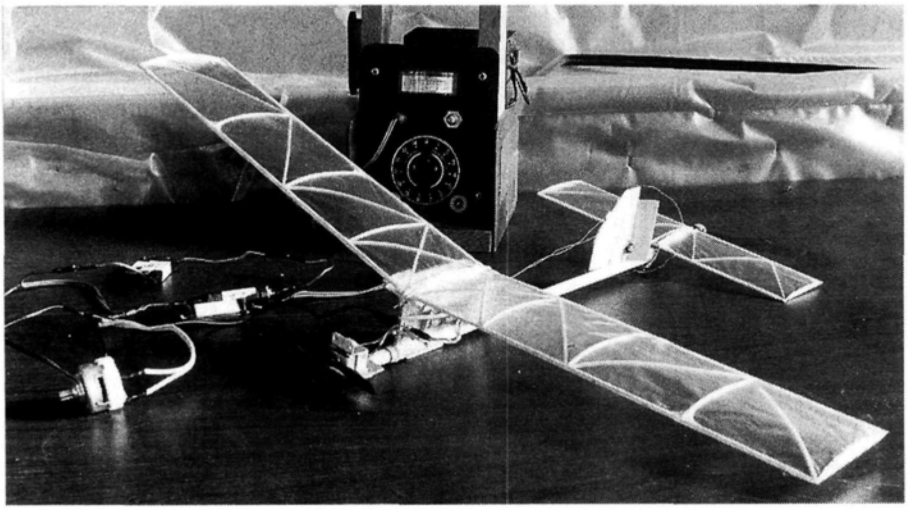
BALSA SELECTION

Balsa selection for larger models is usually made on the basis of strength rather than density. Critical parts like wing spars and fuselage longerons may be spruce with plywood webs for shear strength. Balsa with a density of less than 8 pounds per cubic foot is rarely used, and the exact cross section of a strip or spar is not too critical.

All the rules change with an indoor design. You may try to use 1⁄16x1⁄8 strip instead of 3⁄32 square to realize an 11-percent weight saving with only a minor loss of strength. Available tables allow you to calculate the density of a 3x36-inch balsa sheet from its weight. Once a sheet with the proper springiness and density has been chosen, a balsa stripper is used to slice out adjacent strips of uniform size and very similar characteristics. I used 8-pound wood for the wing's leading and trailing edges and 5-pound wood for the ribs and tail feathers. The pylon is very hard 10-pound balsa.



The airframe for Slow Voltage weighs a scant 12 grams! Most of the model's weight comes from the power system.



ow Voltage and the Fritz Mueller ultra-miniature R/C system (27mHz; nonproportional electro-agnetic actuator).

FUSELAGE

The fuselage is a tube rolled from 6-pound balsa laminated to Tyvec (the same material that's used to make tear-proof envelopes). This provides a lot of strength with only a small weight penalty. Just spread a thin layer of aliphatic glue on the balsa and the Tyvec, allow it to dry, then fuse the sheets together with a hot iron. Now you can pour boiling water over the balsa side and roll or bend it to a very tight radius.

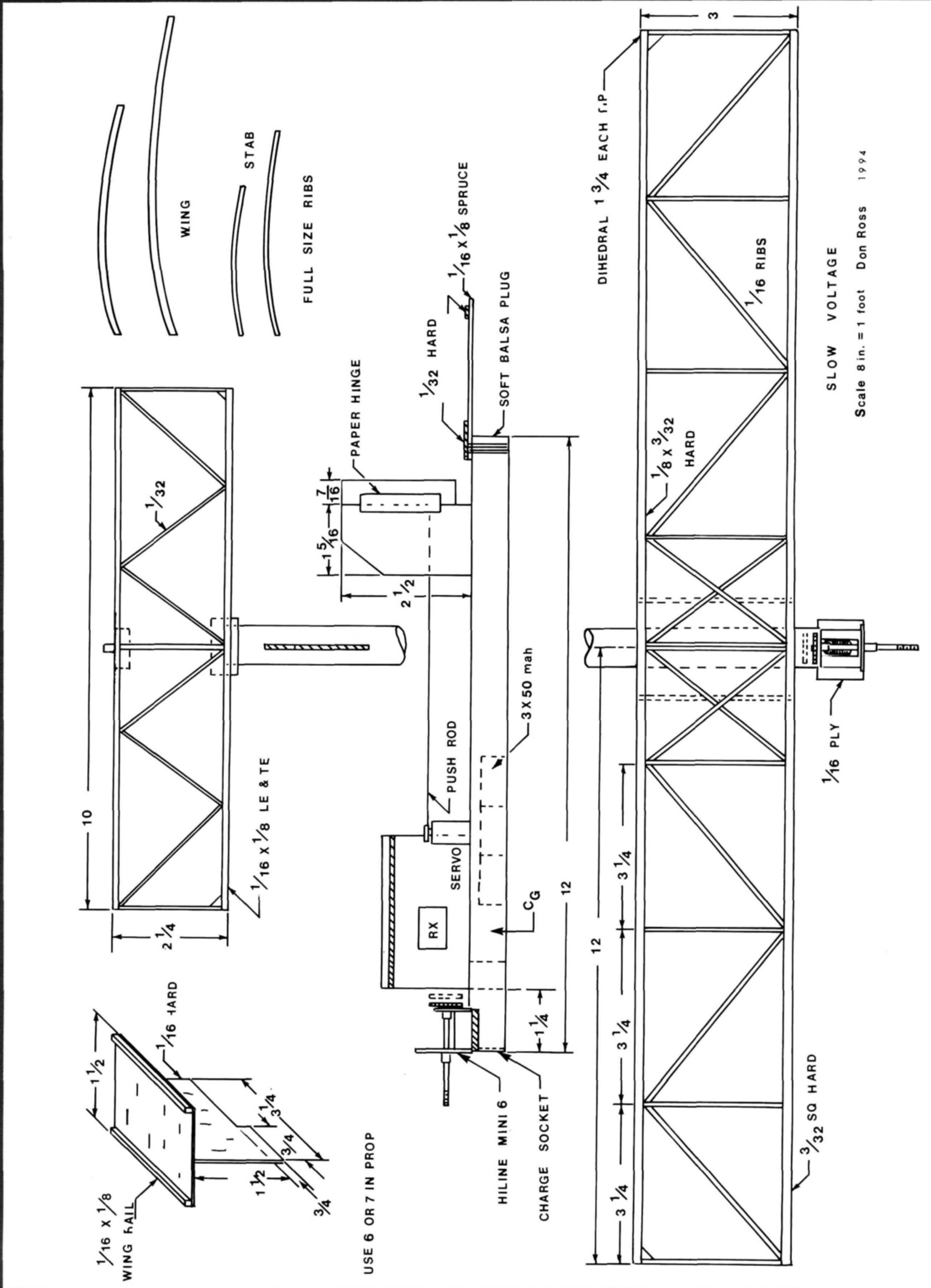
WINGS

Wing construction using sliced ribs arranged across each other adds rigidity and torsional strength with very little weight penalty. Just make a plywood template of the rib curve, slice along the top, then move the template down 3⁄32 inch for the next slice. Jim Jones's* Balsa Stripper and Rib Slicer are dandy tools that deliver strips or ribs to exact dimensions on close tolerances.

SPECIFICATIONS

Name: Slow Voltage
Type: miniature indoor electric
Wingspan: 24 in.
Weight: 2.05 oz. (58 gm.)
Wing loading: 4.09 oz. per sq. ft. (0.8 gm. per sq. in.)
Power: HiLine Mini 6 motor, 3-cell 50mAh battery, 6x6 rubber-powered prop.
Construction: balsa; Tyvec; polyethylene film (supermarket-bag material)

Comments: suited for indoor basketball-court flying and guaranteed fun whatever the weather. *[Editor's note: is this the smallest, practicable R/C craft? Do unconventional, unorthodox designs provide unheralded advantages in this flight regime? Send photos and descriptions of your projects to Debra Sharp, Assistant Editor, Model Airplane News, 251 Danbury Rd, Wilton, CT 06897; fax (203) 762-9803; Internet address: Debs@airage.com.]*


FULL SIZE RIBS
WING
STAB
SLOW VOLTAGE
Scale 8 in. = 1 foot Don Ross 1994
DIHEDRAL 1 3/4 EACH TIP
1/16 RIBS
1/8 X 3/32 HARD
3/32 SQ HARD
1/16 PLY
3
12
3 1/4
3 1/4
3 1/4
3 1/4
1/16 X 1/8 SPRUCE
1/32 HARD
SOFT BALSA PLUG
PAPER HINGE
7/16
1 5/16
2 1/2
3 X 50 mah
PUSH ROD
SERVO
RX
CG
12
1 1/4
HILINE MINI 6
CHARGE SOCKET
USE 6 OR 7 IN PROP
10
2 1/4
1/32
1/16 X 1/8 LE & TE
1/16 HARD
1 1/2
1 3/4
3/4
1 1/2
3/4
1/16 X 1/8 WING RAIL

The 3-cell, 50mAh battery gave flights of 90 seconds, and we were even able to make spot landings as the motor sound indicated dying power.

These building ɜchniques are ıore common ı light, rubber-owered mod-ls than in R/C aircraft, but many of my R/C lub mates agree that such crossovers can be seful. Saving a couple of ounces in a -meter sailplane with no loss of strength an easily result in a significant flight-time ıcrease. An accurate gram scale like the ccculab used with an accurate stripper will elp put strength where needed, while over-ll weight is reduced.

For covering, I had a stock of thin).00033 inch) polyethylene material, which the stuff of which supermarket produce ags are made. Mylar (0.0005-inch thick) is so readily available. I taped the film to a ame, sprayed 3M no. 77 contact cement *ghtly* on the top of each wing and the stab. hen I rolled each onto the film sheet and immed away the excess film with a new ızor blade. A Dennison glue stick (avail-ɔle in any art store) would do just as well. I ›ined the wing halves after covering. The ing and stab are covered on the top only.

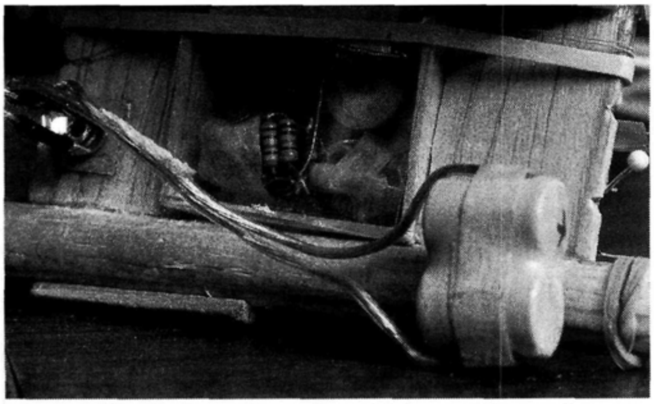
My finished weight came in a bit over tar-ɜt with the wing at 7.5 grams, the fuselage 6.4 grams and the stab at 1.6 grams (the ıdder is part of the fuselage). My all-up eight (with a couple of rubber bands) was ɔw 58 grams (2.05 ounces), with a wing ›ading of 0.80 gm./sq. in. (58/72), or 4.09 z./sq. ft., which I felt was still quite ractical.

FLIGHT TESTS

/ith no stab or motor control, the model ıight climb right into our 31-foot ceiling,) I resorted to an old technique learned om rudder-only flight back in the dark ages of rubber-band actuated escapements. With no control input, the rudder rests at about 11 degrees left. I set the right stop at about 18 degrees, which caused a sharp right bank when the transmitter button was held down. Quick "blipping" of the transmitter resulted in a fairly smooth right turn with almost no bank.

My first guess proved lucky. On the first flight tests, the model climbed slowly left, then banked and descended to the right under steady control pressure. The "blipping" action required a bit of practice, but within a few minutes, I was figure-eighting around the court like a pro. The 3-cell, 50mAh battery gave flights of 90 seconds, and we were even able to make spot landings as the motor sound indicated dying power.

With a successful basic design, I could now consider modifications to improve performance. A call to Fritz Mueller brought the bad news that he no longer had the time to hand-build Albin receiver units. Fortunately, SAMS* of England had just advertised the CETO system. It operates on 27mHz and weighs only 12 grams, including receiver, battery and actuator. Here was a commercial unit that would do the job with only a small weight penalty. The CETO unit is a bit pricey at about $185 (120 English pounds), but I feel other comparable units may soon be available.



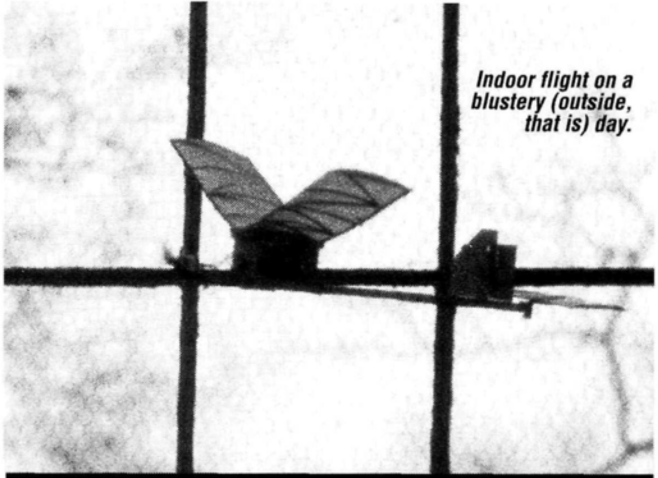
closeup of the Mueller radio receiver. This is a prototype unit; newer ɜrsions use a small, printed circuit board.

The electromagnet actuator is now located near the receiver and operates through a pushrod arrangement. Flying is the same with a slight left turn in the off position, a hard right with steady signal and a gentle right when pulsed.

I tested my model with 4 grams extra weight, and its flight was only a bit faster. With the 12-gram system, I think increasing the wing chord to 4 inches would result in even slower flight with tighter turns. This would result in only a very small weight penalty while significantly reducing the wing loading. If I could build a wing at 8.5 grams with 96 square inches of area, I could shoot for an all-up-weight of 63 to 64 grams that would reduce wing loading from 0.80 to 0.67gm./sq. in. This is a practical target because I've built P-30 outdoor rubber-model wings at not much more than 10 grams.

Now that indoor electric R/C is available to any careful builder, we can plan projects that were only daydreams a few years ago. How about a Farman Moustique with lots of detail, or a WW I Taube capable of aerobatics? With manufacturers racing to build lighter, more efficient systems, the best is yet to come.

**Addresses are listed alphabetically in the Index of Manufacturers on page 177.* ■



Indoor flight on a blustery (outside, that is) day.

Slow Voltage beats bad weather

For much of the country, the four months from June through September just about cover the good outdoor flying season. The cold winter months are for designing, building and maybe some hangar flying at club meetings. With the Slow Voltage, you can scale down your mile-square flying field to basketball-court size at the local school, sip warm coffee while the trees rattle outside and put in 20 flights on a frigid Sunday afternoon. Small electric indoor R/C will not only extend your flying season, but it will also greatly enhance your flying skill. Tight turn recovery and spot landings in a 50x75-foot area will keep you sharp for next season's club meets.

ELECTRICS

ntinued from page 149)

ng the equations, you may choose to use ower gear ratio, such as 4:1, for more n, less pitch and a smaller, standard prop meter.

Then it's time to fly! My experience ows that the calculated results and the fly- results agree quite closely. Having props three sizes is usually enough to zero in on best flying performance. Try it; you'll e it!

*Addresses are listed alphabetically in the Index of nufacturers on page 177. ■

IRWAVES

(ntinued from page 9)

A BETTER TRAINER?

r many years, there has been a great bate regarding what is the best trainer a beginner. Many hundreds of designs ve been produced for this purpose. One ub member destroyed every spare model the club trying to fly; it was only when neone sold him a 1938 OT design that w at about 20mph that he got the hang it.

A recent happening at the field has me ndering if we haven't got it all wrong.

(Continued on page 164)

AIRWAVES

(Continued from page 163)

No model is actually required to learn; a it takes is a computer and the righ program.

Some weeks ago, I produced Dynaflight .60 Mustang for testing at th field. During the first flight, th transmitter was handed to a young ma who had never flown a model. I wa nervous; he just flew the model.

The following week, he was given th transmitter when a new trainer I had ju finished was tested. He flew it for a whil and then pronounced it "boring." When left the field, he was flying an F3A patter ship probably better than I can.

The only training he had was spendin some hours playing with a computer fligl simulator—the Ambrosia AeroChopp program. He had it set up to maximu speed, and enjoyed flying it around th trees and other obstacles inverted.

On his first flight with a trainer, he to off, spent some time doing circles invert and did several takeoffs and landings.

I don't know if this would su everyone, but it might well be worth a tr Perhaps instead of a "club trainer," v should think about a "club computer." might be a lot cheaper in the long run.

The program isn't perfect; it nee some decent default setting and tak some knowledge to set it up for the be use. It is, however, far better th destroying models while learning to fly. might also be handy during your lo northern winters!

MAL RICHARD
Whangarei, New Zeala

Mal, computers can enhance the sport many ways. Look for an article Ambrosia's AeroChopper program a other flight simulators in a future issu Also, check out the survey of 32 softwa programs for modelers in this issue. G

BACK TO THE SUPER BUCK

Recently, I was looking through some c copies of your magazine, and I spotted plane that I built back in 1940. It was Super Buccaneer. The article was in t April '71 issue on page 38. The auth was Chuck Gill. Well, did this article ev bring back memories! I have be building model aircraft since 1938. I w away from modeling for about 25 yea while our children were growing up an had no place to fly. Now that I'm retir and back into modeling, I have a questio

Is there any place that I could get a of plans of the same ship that you show

(Continued on page 1

AIRWAVES

(Continued from page 164)

the article by Mr. Gill? I would lov nothing better than to build one or man new Super Bucks. I now live in nort central Pennsylvania, and I have all th room I need to fly. I would like t introduce free-flight to our club—th Mountain Modellaires. Most of th fellows and ladies are around my age bu no one seems to want to start. I remembe having many, many great flights with tha model airplane. I certainly hope you ca help in this matter. Thank you.

JOHN R. WILSO
Middlebury Center, P

John, there is definitely something specia about "old timer" models and th modelers who built and flew them. W published an article by Frank Gudaitis i our November '94 issue about the Societ of Antique Modelers. There are man modelers worldwide who enjoy O models. If you'd like to learn more abou this organization, or you'd like to joi contact Larry Clark, Box 528, Lucern Valley, CA 92326.

We called Chuck Gill about his Apr '71 article (the same Chuck Gill who no runs The Aeroplane Works), and he sai that the plans are still available from couple of sources.

The best bet would be to contact Bi Effinger, the former owner of Berkle Models and the designer of the Supe Buccaneer. He can be reached at hi company: W.E. Technical Services, Rte. Box 2900, Santa Rosa Beach, FL 3245 Another source of plans (and the plac where Chuck Gill obtained his original s of plans) is John Pond's Old Time Pla Service, P.O. Box 90310, San Jose, C 95109-3310; (408) 292-3382. Finally, you want to talk to Chuck Gill about th Super Buck, Chuck says he'd love to hea from you or any reader who is intereste in OT models. Chuck can be reached The Aeroplane Works, 2134 Gilbridg Rd., Martinsville, NJ 08836; (908) 35 8557.

Building and flying an OT mod should help to convince your friends t join in on the fun. Good luck on your O recruiting mission. G

BUILD A BRONCO?

I'm inquiring about plans for the Nor American OV-10A Bronco. A friend le me in your direction; I hope you can hel How much do the plans cost? Thank you.

PAUL C. CLAR
Dubuque, I

(Continued on page 16

AIRWAVES

(Continued from page 166)

Paul, plans (no. FSP09681) for the OV-10A, designed by Frank Capan, appeared in the September '68 issue of Model Airplane News. At the time, the model was a consistent winner at scale contests and had very good single-engine performance. By today's scale standards, it's a bit on the simple side, but it's still a good, stable flier. The 68-inch-span model is built using traditional balsa/plywood construction and was designed for two .60 2-stroke engines. The two sheets of plans cost $22 plus $3 S&H.

If that one is too big, stay tuned! A great little Bronco for twin .25s is in the works right now. It has a wingspan of approximately 52 inches. The designer, Rich Uravitch, says that this one flies like a charm and looks just as sinister as the full-size counterinsurgency aircraft. The subject of a future construction article, this model is sure to be a winner on every builder's list. You can order plans for the larger Bronco by calling (800) 243-6685. Good luck with your future project. GY

ARMATURE RESISTANCE

We'd like to thank Tom Hunt for mentioning AERO*COMP, our software, for performance analysis of electric-powered models in his recent product review ("Astro Flight's FAI 25-5T and 40-5T Motors," October '94 issue). This letter adds to Tom's very interesting comments about motor testing.

The "armature resistance" that Tom discusses actually includes not only the resistance of the armature windings, but also the resistance of the brushes where they contact the commutator. Tom suggests that the armature resistar should be measured when the motor stationary. The trouble with this is that brush resistance isn't the same when motor is running, and the brush resistar is often significant relative to resistance of the windings. Therefo armature-resistance measureme obtained from stalled motors may inaccurate values that lead to pc estimates of motor performance. particular concern is the situation in wh the armature-resistance measurement too low, resulting in current and r predictions that are too high. If the r estimates are too high, then the airpl will not perform as well as calculations say it should.

The solution to this problem is measure the motor resistance while

ıtor is turning. One way to do this is scribed in the help screens in :RO*COMP. Interested readers may ite to us for a free printout describing : method. (We also use two other thods to measure, confirm and refine motor data that we provide with the tware.)

Electric motors also suffer from chanical losses, such as bearing ction, viscous losses caused by air wing around the rotating armature and on. The mechanical losses are netimes handled by means of a "loss rent," which is notoriously inaccurate l difficult to measure. We do not use a s-current approach in AERO*COMP; ıer, we compute the mechanical loss ng fundamental physical principles. : resulting estimates of rpm, current l thrust are very accurate, even at h rpm.

PAUL R. OGUSHWITZ, Ph.D.
Hackettstown, NJ

ınks for your comments, Paul. Readers ɔ find the technical details of motor ing a bit on the arcane side need not ry that they must become physicists to and analyze motors or to best match n to props and aircraft! But it will help ɔu have a PC.

*'wo software packages written for IBM s and compatibles—AERO*COMP and ctroflight Design—provide any ıisitive modeler who has a suitable PC ı a powerful means of assessing motor ıabilities and predicting flight formance of electric-powered model raft (glow-powered models can also simulated). Both programs offer elp" screens on motor-testing cedures, and both use the values erated by these tests, along with other ameters, to predict aircraft formance. Both programs allow the r to play with a huge variety of ımptions that range from propeller ice to basic aircraft attributes.*

*ıERO*COMP, published by U.S. R&D p., P.O. Box 753, Hackettstown, NJ 40-0753, (908) 850-4131, includes ıes for more than 100 commercially ilable motors. Another powerful kage is Electroflight Design, sold by ss Jets, Inc., 4308 Ulster Landing, gerties, NY 12477; (914) 336-8149. s program has some very intriguing abilities in terms of defining the imal propeller for a model aircraft hough both programs can be used for purpose).* TA

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AeroChopper; Ambrosia MicroComputer, 98 W. 63 St., Ste. 371, Willowbrook, IL 60514; (708) 655-0610.

Aerrow Inc., P.O. Box 183, Perth, Ontario, Canada K7H 3E3;. (613) 264-0010; fax (613) 264-8441.

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SAMS, The Chapel, Roe Green, Sandon, Buntingford, Herts SG9 OQJ England; 011-44-763-288384.

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Scale Model Research, 3114 Yukon Ave., Costa Mesa, CA 92626.

Sermos R/C Snap Connectors Inc., Cedar Corners Station, Box 16787, Stamford, CT 06905.

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SR Batteries Inc., Box 287, Bellport, NY 11713.

The New England Parachute Co., P.O. Box 126, Hampton, CT 06247; (203) 779-0229

Top Flite, P.O. Box 9021, Champaign, IL 61826-9021.

VL Products; Div. Vista Labs, 7871 Alabama Ave. #16, Canoga Park, CA 91304; (818) 348-8039.

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I certify that the statements made by me above are cor-and complete.

—Gary W. Dolzall
Associate Publisher

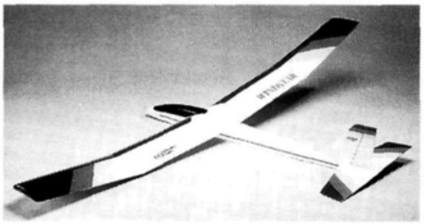
PRODUCT NEWS

GLOBAL HOBBY DISTRIBUTORS
Raven

The Raven features high-quality, die- and machine-cut balsa; hardwood and balsa plywood parts; a crystal-clear molded canopy; a custom spinner; custom Raven decals; molded wheel pants; and wire main gear. It's capable of performing aerobatics with a .60 2-stroke or a .90 4-stroke engine. Specifications: length—40.5/50.5 inches; wingspan—62 inches; wing area—638 square inches; engine—.60 to .65 2-stroke; radio—4-channel.

Kit no.—232320; **price**—$119.99.

Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728-8610; (714) 963-0133.



THUNDER TIGER USA
Windstar

The Windstar is a 2-meter ARF sailplane that's handcrafted out of select wood and covered in lightweight film. It requires only final assembly and radio installation. Specifications: wingspan—77.3 inches; wing area—574 square inches; length—44 1/2 inches; weight—32 to 39 ounces; wing loading—8 to 9.7 ounces per square foot; radio—2-channel.

Kit no.—4102; **price**—$114.99.

Thunder Tiger USA Inc., 2430 Lacy Ln. #120, Dallas, TX 75006; (214) 243-8238.

SCALE SPECIALTIES
Pilot Figures

These pilot figures feature a lightweight, one-piece, hollow molding with complete detail right down to the "AN-6530" goggles and "B-4"-style life jacket. WW II Navy and Air Force pilots are available in 1/6.5 and 1/5.5 scales. Painted and finished figures are also available. For a catalogue and a price list, send $1 (refundable with purchase).

Prices—start at $60.

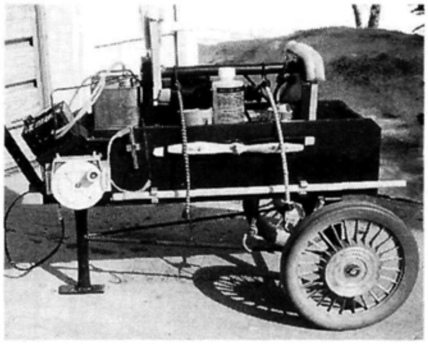
Scale Specialties, P.O. Box 50791, Phoenix, AZ 85076; (602) 899-8830 (days), (602) 464-4699 (evenings).

INNOVATIVE MODEL PRODUCTS
P-47D Thunderbolt

This 1/6-scale Republic P-47D Thunderbolt kit features a one-piece fuselage with wing fillets and panel lines. All the scale details, such as a spinner, a static spinner, static prop blades, a cockpit kit and retracts and tires are also available. The built-up tail feathers are covered with fabric. Specifications: wingspan—77.5 inches; engine—.90 to 1.08 (or larger) 2-stroke, or 1.20 (or larger) 4-stroke.

Price—$319.95.

Innovative Model Products, P.O. Box 4365, Margate, FL, 33063; (305) 978-9033.

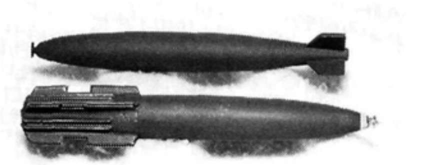


MR. HOUSEFLY
Mobile Field Fly Box

Mr. Housefly offers you plans to build your own Mobile Field Fly Box. It can carry your fuel can, battery pack, starter, power panel, fuel pump, transmitter, spare props, tools and your model. You can start your engine right on the Fly Box; you don't have to get on your knees.

Price—$21.95 (includes S&H).

Mr. Housefly, 1008 W. 6th St., Ida Grove, IA 51445; (712) 364-3596.



EAGLE MINIATURES INC.
Mk 82 Bombs

Eagle Miniatures Inc. offers two versions of the Mk 82 500-pound bomb for use on modern aircraft. The low-drag, general-purpose Mk 82 500-pound bomb (top) is available in 1/7 and 1/10 scale, with parts for four bombs in each kit. The Mk 82 Snakeye version (bottom) is available in 1/10 scale, and each kit will produce a pair of bombs. Both kits have very lightweight construction. For more information, send $2 and an SASE.

Kit nos.—1-527-4 (Mk 82 500-pound, 1/7 scale), 1-520-4 (Mk 82 500-pound, 1/10 scale), 1-570-2 (Mk 82 Snakeye); **prices**—$22, $20, $14.

Eagle Miniatures Inc., P.O. Box 468, Streamwood, IL 60107; (708) 483-2210.

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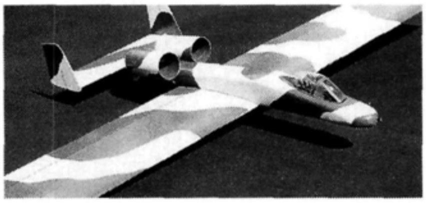
To find the nearest “Made in the USA” hobby dealer, just look for the “DAD” sign, or call (800) 669-4548.

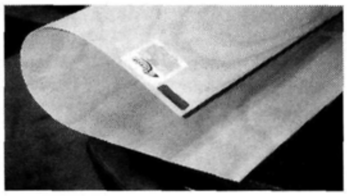


AEROTECH
Fairchild A-10 "Warthog" Glider

Designed by Jef Raskin, the Fairchild A-10 “Warthog” tank killer is an excellent glider that brings a touch of realism to slope soaring. Rugged, Anabat-style composite construction allows this ship to take a beating and keep on flying! The easy-to-build A-10 offers precise handing and is “hands-off” stable. With this elevator/aileron ship, you’ll experience the thrills of flying aerobatics and inverted. Contact combat, anyone? It’s offered with covering and hardware.

Price—$49.95 (introductory).

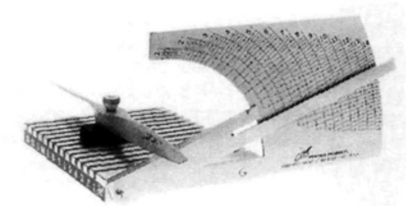
Aerotech, 411 Beach Park Blvd., Foster City, CA 94404; (800) 573-9363.



RITECO SUPPLY INC.
Hoop Pine Plywood

This premium, flexible plywood has been made in Australia since 1917, but it has never before been sold in the U.S. On all sheets, both sides have been finely sanded to ensure an ideal surface for die-cutting, gluing and painting, and you *won’t* find open-hole knots or compressed areas. This strong, durable wood’s unique flexibility and tight grain make it ideal for bending. Available in 3x6-foot sheets in thicknesses of 1/16 and 1/8 inch, and in 4x8-foot sheets of other thicknesses.

Riteco Supply, Inc., 12999 FM 529, Houston, TX 77041; (713) 896-6200; fax (713) 896-6100.



PRATHER PRODUCTS INC.
Prop Pitch Gauge

The Prather Prop Pitch Gauge is available again. It works on props of up to 12 inches in diameter and with 3 to 15 inches of pitch. It allows you to true both blades (on many propellers, the two blades differ in pitch) and also to adjust pitch to ensure maximum prop/engine performance. Complete instructions are included, and there are tips on how to get the best performance out of your prop and engine.

Price—$59.95; **part no.**—7050.

Prather Products Inc., 1660 Ravenna Ave., Wilmington, CA 90744; (310) 835-4764; fax (310) 835-0810.

BALSA USA
USA Gold CA

Balsa USA’s Gold CA bonds balsa, spruce, plywood, fiberglass and plastics—no more need for specialty CAs. Gold CA is triple-distilled to ensure maximum bonding strength and long shelf life (24 months unopened). Its tensile strengths are 4,200 to 4,800 pounds, and it will withstand a 50-pound shock! Regardless of the surface to be glued (alkaline or acidic), Gold CA compensates for surface pH, so a superior bond is guaranteed. For more information, send an SASE marked “The Facts About CA Adhesives” to Balsa USA.

Balsa USA, P.O. Box 164, Marinette, WI 564143.

LITE MACHINES CORP.
LMH-100 Helicopter

Fly this durable helicopter with a Cox TD .049 or .051! Its main rotor has semi-flexible plastic blades that fold upward in a crash. The kit includes: patented Arlton Gyro Stabilizer on the tail rotor; machined clutch and heat sink for the engine; and step-by-step, illustrated instructions. Requires a 4-channel airplane radio; micro-servos; an engine; and an Ace throttle sleeve.

Lite Machines Corp., 1132 Anthrop Dr., W. Lafayette, IN 47906; (317) 463-0959.

Descriptions of products appearing in these pages were derived from press releases by the manufacturers and/or their advertising agencies. The information given here does not constitute endorsement by **Model Airplane News**, nor does it guarantee product performance. *When writing to the manufacturer about any product described here,* be sure to mention that you read about it in **Model Airplane News**. **Manufacturers!** To have your products featured here, address the press releases to **Model Airplane News,** attention: Product News, 251 Danbury Rd., Wilton, CT 06897.

NAME THAT PLANE

CAN YOU IDENTIFY THIS AIRCRAFT?

If you can, send your answer to *Model Airplane News*, **Name That Plane Contest** (state issue in which plane appeared), 251 Danbury Rd., Wilton, CT 06897.

Congratulations to Elmer Cunningham of East Alton, IL, for correctly identifying the October mystery plane. The amphibious, single-engine Supermarine Walrus biplane was designed specially for observation and rescue missions. With its 45-foot, 10-inch wingspan and length of 37 feet, 7 inches, it weighed 7,200 pounds when loaded and had a maximum speed of 124mph and cruising range of 600 miles. The Royal Australian Air Force ordered a number of Walruses and gave it the designation "Seagull V." In 1935, it was adopted by the British Admiralty and used in the Fleet Air Arm. Powered by a Bristol Pegasus VI 9-cylinder, radial, air-cooled engine, the Walrus was the first amphibian to be catapulted with a full military load, and it was used by all Fleet vessels equipped with catapult launching gear.

The winner will be drawn four weeks following publication from correct answers received (on a postcard delivered by U.S. Mail), and will receive a free one-year subscription to **Model Airplane News**. If already a subscriber, the winner will receive a free one-year extension of his subscription.

CLUB OF THE MONTH

NORTH WEST R/C CLUB

11131 Utah Ave. N., Champlin, MN 55316-3752

The "North West Angle," the monthly newsletter of this R/C club from Minnesota, is informative, friendly and entertaining. In addition to personal letters from the club president and vice president, the September '94 edition features upcoming events, members' birthdays, aviation "Aviersaries" and "Trader's Time," a column for free classified ads.

Don Householder offers some noise-reducing tips in "All Fueled Up and Nowhere to Fly" (or "The Over 90dB Blues"), including flying tighter patterns, using larger props and reducing rpm. An unusual column, "Tech Trix," describes how to use everyday items in model airplane applications and vice versa; this month, it describes how to use leftover fuel line to fix a plumbing problem.

Another article discusses the Planes of Fame Air Museum in Eden Prairie, MN, whose coordinators are looking for R/C model airplanes for special events and static display models for permanent exhibits. What a great way to simultaneously promote R/C and show off scale building skills!

Proving that good modelers are also good neighbors, the North West R/C Club donated 185 pounds of food and $100 from the proceeds of their '94 Big Bird & Warbird Fly-In to a local charity.

For their success on the field and in their community, we award the North West R/C Club two complimentary subscriptions to *Model Airplane News*. Congratulations. ■

CLASSIFIEDS

RATES: non-commercial—25 cents per word (no commercial ads of any kind accepted at this rate); commercial— 50 cents per word (applies to retailers, manufacturers, etc.); count all initials, numbers, name and address, city, state, zip code and phone number. **All ads must be paid for in advance.** To run your ad for more than one month, multiply your payment by the number of months you want it to run. Deadline: the 10th day of the month, 3 months in advance, e.g., *January 10 for the April issue.* We don't furnish box numbers, and it isn't our policy to send tear sheets. **SEND AD AND PAYMENT TO: JILL MOLINARO, CLASSIFIED ADS, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897-3035, or call (203) 834-2326.**

R/C WORLD ORLANDO, FL, CONDO RENTAL: 2 bedroom, furnished. Available weekly or monthly. Low rates. 100-acre flying field with enclosed hangars. Close to Disney World and Epcot Center. For information, please call or write to R/C World, 1302 Stearman Ct., Orlando, FL 32825; (407) 380-6359.

WANTED: built or partially built Ercoupes, Cessna 150, 152, 172, 182, Grumman American Tiger (AA5), American Yankee (AA1), or Mooney M-10 Cadet. Glen Mills, P.O. Box 3393, Mission Viejo, CA 92690; (714) 768-0585. [5/95]

PLANS ENLARGED. Scanning/plotting services; model designer's computer software; free information. Concept, P.O. Box 669E, Poway, CA 92074-0669; (619) 486-2464.

MAKE REAL DECALS with your computer and printer! Send $10 for starter kit and instructions to LABCO, 27563 Dover, Warren, MI 48093-4764. [5/95]

ENGINES: IGNITION, GLOW, DIESEL—new, used, collectors, runners. Sell, trade, buy. Send $3 for huge list to Rob Eierman, 504 Las Posas, Ridgecrest, CA 93555; (619) 375-5537. [5/95]

MODEL MOTORS WANTED—Most types, 1970 and earlier. Cash or trade. T. Crouss, 100 Smyrna, West Springfield, MA 01089. [3/95]

ANTIQUE IGNITION engine parts: excellent reproductions, fuel tanks, points, timers, coils, needle valves, gaskets, etc. Champion spark plugs. Catalogue—$5 (intl. airmail—$7). Aero-Electric, 1301 W. Lafayette St., Sturgis, MI 49091. [2/95]

WANTED: ignition model engines 1930s to 1950s, especially Elf, Baby Cyclone, Brown Jr., Ohlsson Custom and Gold Seal. Also model racecars, any parts, spark plugs, etc.; Woody Bartelt, 1301 W. Lafayette St., Sturgis, MI 49091; (616) 665-9693, or (800) 982-5464. [2/95]

GERMAN AIRCRAFT WW II—handbooks, service part lists, instruction manuals. List—$2. Udo E Hafner, Eugen-Bolz-Str. 15, D-71636 Ludwigsburg, Germany. [5/95]

FLY DAVE BROWN SIMULATOR. Use your transmitter. Works with Futaba, JR, Airtronics, Hitec. Uses Standard joystick connection. For more info, contact Computer Designs, 8530 N. Montana Ave., Helena, MT 59601;(406) 458-9416. [1/95]

ULTRALIGHT AIRCRAFT. New publication has plenty of information, pictures and stories on this exciting flying sport. Buy, sell, trade and kit-built aircraft. You can learn to fly the real thing. Fixed wing, powered parachutes, rotor, balloons and blimps. Sample issue $3. Annual subscription $36. Introductory offer of only $24. "Ultraflight Magazine," 12545 70th St. N., Largo, Fl 34643-3025. [1/95]

AIRSHIPS (MAN): Technical, history, tapes, collectibles. 522 E. Vine, Box 213, W. Covina, CA 91790. [2/95]

MODEL GRAPHICS/VINYL LETTERING. Introducing new 20-page instructional catalogue and model decorating guide. Special offer: any combination of 10, 2-inch letters or numbers, custom-cut and ready to install, with catalogue—$4.95. Graphics A.M.P. Inc., 42a Nancy St., W. Babylon, NY 11704; (516) 253-2702. [2/95]

R/C SKYDIVING–illustrated catalogue: $1. R/C Skydivers, Box 662N, St. Croix Falls, WI 54024. [2/95]

ANTIQUE IGNITION-GLOW PARTS CATALOGUE, ½-inch thick, timers, needle valves, cylinder heads, pistons, points, tanks, spark plugs, racecar parts. Engines: ½As, Baby Cyclones, McCoys, Phantoms, etc. $8 postpaid (U.S.); $20 foreign, Chris Rossbach, R.D. 1, Queensboro Manor, Box 390, Gloversville, N.Y. 12078. [2/95]

SODA-CAN AIRPLANES—replica biplane detail plans with photos $7.50 PPD, Early's Craft, 15069 Valley Blvd. SP 26, Fontana, CA 92335. [8/95]

CARS. Selling model collection, 1973 issues up, 1/24-1/25, individual prices, about 800. Ralph, Box 2423-P, Yakima, WA; (509) 965-0670. [5/95]

1995 ANTIQUE model airplane engine calendar—$10. Allow 8 weeks for delivery. Alan Mironer, 269 Concord Rd., Bedford, MA 01730. [1/95]

"REPRODUCE ALMOST ANYTHING": plastic, metal, rubber, plaster, ceramic parts. 40-minute "Basic Silicone Mold Making" videotape shows simple, step-by-step techniques used by movie model makers. A 44-page manual expands on the videotape and includes a nationwide source list of materials—a must for the serious hobbyist. Make better models and/or greater profits. $39.95 plus $3.50 S&H. California residents add $3.30 sales tax. Cherokee Accessories, 4127 Bay St., Ste. 226 M, Fremont, CA 94538. [2/95]

DO YOU SPEAK MODEL AIRPLANE? Seventy years of aeromodeling history! All the heroes, contests, models! Paperback, 320 pages, $19.95 postpaid. Also: Old Buzzard's Soaring Book, $16.95. Dave Thornburg, 5 Monticello, Albuquerque, NM 87123; (505) 299-8749 for Visa/MC. [6/95]

NEW ZEALAND AERO PRODUCTS. Scale plans: Agwagon, Pawnee, Pawnee Brave, Airtruk/Skyfarmer, Fletcher FU-24, Aerobat, Hall's Springfield Bulldog, Typhoon, DC-3/C-47, Fairchild PT-19/Fleet PT-26, RNZAF CT-4B Airtrainer/CT-4C Turbine Airtrainer and more. Fiberglass parts, hardware packs, color photo packs available. Free documentation with plans. Catalogue/price list (USD)—$5; Visa/MC. 34 Ward Parade, Stirling Point, Bluff, New Zealand; (03)2128192. [2/95]

GIANT SCALE PLANS–drafted by Warren P. Russel of New Zealand. Send SASE to: Alaska Aero Products, P.O. Box 5003, Nikolaevsk, AK 99556-5003. [1/95]

WANTED: old kits and plans of R/C models from the '50s, '60s and '70s–especially Goldberg, Jetco Top Flite, Sterling and Midwest kits or plans. Willing to pay for duplication of plans. Call Gene (214) 494-0323. [2/95]

SWOOSHIE BAILS OUT! Release a scale-like parachutist! A real crowd-pleaser and a lot of fun! For a brochure, send SASE to Hobby Hut Mfg., 2020 W. 21st N. Ste. #77, Wichita, KS 67203-2107, Dept. MAN. [4/95]

WANTED: Model engines and racecars before 1950. Don Blackburn, P.O. Box 15143, Amarillo, TX 79105; (806) 622-1657. [10/95]

R/C HELICOPTER TRAINING COURSE. One-on-one personalized instruction with your equipment or ours. Three-day course located at beachside resort community in sunny Florida. Call (904) 441-0347 (evenings). [1/95]

GEE BEE plans utilized for Benjamin's full-scale R-2, Eicher/Kimball "Z"; Jenkins' "Bulldog." ⅓, ¼, ⅙ through 1/24 scale, 10 airplanes. Shirts! Plans! Catalogue/news—$4, refundable. Vern Clements, 308 Palo Alto, Caldwell, ID 83605; (208) 459-7608. [1/95]

EZ KITS WANTED. Any 40-size EZ Warbirds. Cash or trade for O.S. engines. Will pay shipping. Pat Williams, 2125 Forrest Lake Dr., Cincinnati, OH 45244; (513) 474-1559. [1/95]

WANTED: Old wooden kits, magazines, WW II IDs and Mfgrs. models. Bill Fornwalt, 103 Dartmouth Ave., Johnstown, PA 15905. [2/95]

MAGAZINE BACK ISSUES—*American Modeler, American Aircraft Modeler, Aeromodeller, Model Airplane News, Model Aircraft, RCM* and more; 1930s–1990s. For list, send SASE to Carolyn Gierke, 1276 Ransom Rd., Lancaster, NY 14086. [3/95]

R/C SAILPLANES—scale, sport, electric. SAM and NFFS powered, towline, Wakefield. F/F scale and sport powered, rubber, towline. Formerly B2 Streamlines Plans Service. Catalogue $2—all models illustrated. Cirrus Aviation, P.O. Box 7093, Depot 4, Victoria, BC, Canada V9B 4Z2. [3/95]

WANTED: OLD, ready-to-run, gas-powered cars, airplanes and boats. Complete or parts. Please write: Dean Barham, 4032 Iowa St., San Diego, CA 92104; (619) 528-1680. [3/95]

MOLD-MAKING/CASTING GUIDEBOOKS—complete techniques and sources of rubbers, plastics, resins, metals and more. For information, contact Castech-MA, Box 16586, Memphis, TN 38186-0586. [3/95]

DRAWINGS ACCURATELY enlarged and copied. Any scale; any size; three-views; magazine plans; old-timers; antiques. Money-back guarantee. Send $2 for info. Roland Friestad, 221 MAN 155th St., Cameron, IL 61423. [5/95]

WANTED: early O.S. FT-120 Gemini crankshaft, part no. 46002005. Earl Colley, 202 Fair Park Ave., Henderson, TX; (903) 657-3605. [3/95]

OLD-TIME ENGINES, kits and plans. Send SAE and 50 cents for list. T. Alden, 2660 Balaclava St., Vancouver, B.C., Canada V6K 4E2 [3/95]

DEBOLT PLANES–radio control, free-flight, control-line. Send sepe ate SASE for each list to Fran Ptaszkiewicz 23 Marlee Dr., Tonawand NY 14150-4321. [3/95

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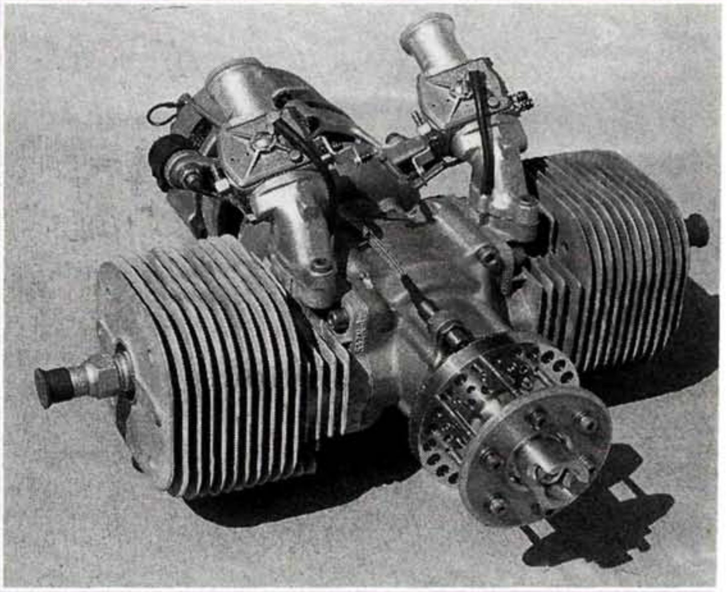
ADVERTISER INDEX

FINAL APPROACH

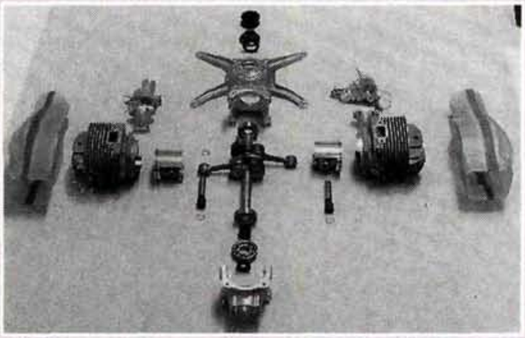
HOW BIG IS BIG ENOUGH'

A mystery engine appeared at the May '94 Unlimited Races at Galveston, TX. The dual-carb, opposed-cylinder Dyad manufactured by Herbrandson Engines* is among the most powerful R/C powerplants in the world. The fruit of a decades-long unmanned air vehicle (UAV) engine development program, the Dyad line has benefited from thousands of hours of bench-testing and literally millions of dollars of government-funded R&D. These are ultra-reliable, relatively low-rpm, high-torque, gas-drinking, mil-spec UAV engines.



The 21.3hp, 216cc (13.1ci) dual-carb Herbrandson engine is making inroa unlimited racing. This version is provided with "chain-saw" cylinders; wi an ignition system, it's listed at approximately $2,500.

Enter the unlimited races. Three variants, originally designed in the '70s, have appeared on the racing scene—a 216cc engine, a 280cc version (both weigh approximately 12.6 pounds) and a 27.5hp, 301cc Goliath (13.8 pounds). The racing versions use chain-saw cylinders (the compression of the mil-spec cylinders would defeat R/C starters) and, like the other top engines on the unlimited racing scene (e.g., the 198cc Aerrow* 200 and the 145cc A-cubed*), their performance is remarkable. Respectively, the three gas Dyad engines spin 24x28, 24x30 and 25x30 props at approximately 8,000rpm in flight. The engines are robust (three main ball bearings on the crankshaft); there is significant room for power enhancement.



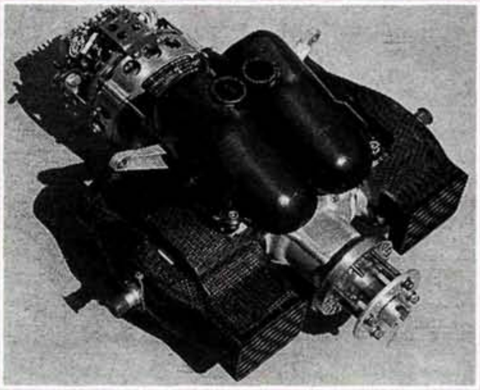
An exploded view of the 25hp 280cc Herbrandson. The aluminum cylinders have a 450-hour useful life before the hard-chrome plated bore wears through above the exhaust port. Note the single compression ring.

The gas versions already enjoy a power-to-weight ratio sufficient to pull most ¼-scale model aircraft to 200mph, which, for many, is terminal velocity. Nonetheless, the spirit of competition has led a number of racers to convert these engines to methanol, which can provide up to an 8 percent power gain. On methanol with 20 percent nitromethane, a 25 percent power gain is reasonable.

AT THE RACES

The Herbrandson Dyad, like other monster R/C engines, raises some provocative questions. Can modelers build proper airframes for this much power? Will pilots be able to visually follow race planes as speeds continue to climb?

The record only deepens



The 280cc (17ci) mil-spec Herbrandson unmanned aerial vehicle (UAV) pusher engine is cloaked in a graphite-epoxy shroud that directs air over the cylinder fins. Louvers at the rear minimize the enclosed engine's infrared signature. The gear at the front is a 1500W alternator.

the mystery. At Madera '94, a Dyad-powered plane the fastest qualifier (lap time, not air speed), but a D did not take home the gold. One of the probl encountered was fuel starvation. Thousands of hou bench-testing a UAV engine had not forecast extreme turbulence that would occur near the intakes in a live, racing environment. That turbul upset the balance pressure on the dry side of the m ing diaphragm. A simple solution was found, but until late in the race. Several planes racing D engines experienced DNFs or crashed owin structural failures. These outcomes all hint at the lenge of coping with unprecedented power and technology. (Rob Wood will provide the detail Madera '94 in an upcoming feature article.)

The biggest engines have not always been the l ers. The 145cc (8.8ci) A-cubed took first-place go the '94 Galveston and Madera races. Yet the pres greater power understandably, and inevitably, proce

One developer speculate the feasibility of a 1C Wankel that puts out horses. Motorcycle engine the 250cc range are gener well over 50 horses, require bulky tuned-exh systems. But is bigger alv better? Could it be that, in out competition, there point of diminishing ret with respect to po enhancement? Engines the Herbrandson Dyad these interesting questions

—Tom Atw

*Addresses are listed in the In Manufacturers on page 177